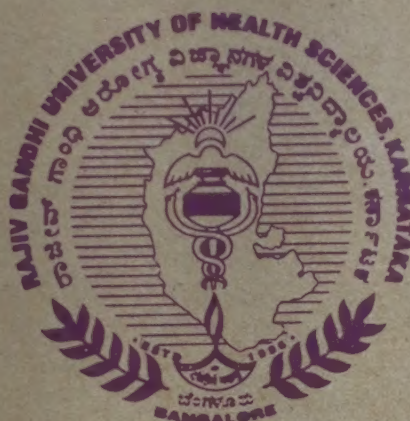


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**RAJIV GANDHI UNIVERSITY  
OF HEALTH SCIENCES  
KARNATAKA**

**BANGALORE - 560 041**



**ORDINANCE RELATING TO  
BACHELOR OF PHARMACY  
COURSE**

**1997**



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KARNATAKA**

**BANGALORE - 560 041**

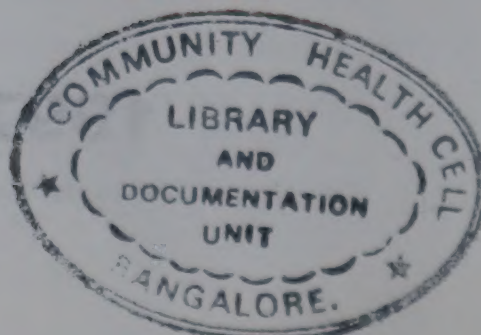
**ORDINANCE RELATING TO  
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UNIVERSITY OF HEALTH SCIENCES  
KARNATAKA  
BANGALORE - 560 041  
BACHELOR OF PHARMACY  
COURSE

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**Note:** Amendments made upto February 1998 have been incorporated





**RAJIV GANDHI UNIVERSITY  
OF HEALTH SCIENCES  
BANGALORE - 560 041, KARNATAKA**

No. ACA/ORD.6/97-98.

Date: 20.08.1997

**NOTIFICATION**

*Sub:* Ordinances in the matter of admission, courses of study and scheme of examination relating to B.Pharm course

*Ref:* Minutes of the Meeting of the syndicate held on 7th August 1997.

- - -

Under section 35(2) of Rajiv Gandhi University of Health Science Act, 1994 an ordinance 1997, governing Admission, course of study, and scheme of examination relating to B.Pharm Course as approved by the syndicate at the meeting referred to above is hereby notified as given in the schedule here to appended.

The above ordinance relating to B.Pharm Course shall come into force from the academic year 1997-98.

By Order

Sd/-  
Registrar

To :

1. The Principals of Pharmacy Colleges affiliated to RGUHS.
2. The Members of the Syndicate/Senate/Chairmen of Board of Studies.
3. Secretary to Governor, Karnataka State, Raj Bhavan, Bangalore - 560 001.
4. Secretary to Government of Karnataka, Health and Family Welfare Department, M.S. Buildings, Bangalore - 560 001.
5. All Officers in the University.
6. Academic and Examination Branch.
7. P.S. to V.C. /Regr./Regr. (Ev.) /F.O.







**Rajiv Gandhi University of Health Sciences, Karnataka, Bangalore – 560 041.**

**Ordinance relating to Bachelor of Pharmacy Course 1997.**

**ERRATA**

Page NO.	Item	Printed as	Change	Read as
3	IX (a) Third line	Viva and Sessional) and practical aggregate (university practical plus viva and	Delete "plus viva"	Viva and Sessional) and practical aggregate (university practical and
4	XI Fifth line	shall be forwarded to the university atleast 15 days prior to the commencement the next	Add "of" after "commencement":	shall be forwarded to the university atleast 15 days prior to the commencement of the next
4	XII Fourth line	who are exempted in the Introductory Biology and Introductory Mathematics by the Bangalore	Delete "Bangalore"	who are exempted in the Introductory Biology and Introductory Mathematics by the
4	XIII Third line	hours to be covered in not less than one hundred and fifty hours to be covered in not less	Delete "in not less than one hundred and fifty hours to be covered"	hours to be covered in not less
6	Table II, Title of 6 <sup>th</sup> column	Max. Marks for written papers	Add "Uni"	Max. Marks for Uni. Written papers
6	Table II 1.1 Introductory Mathematics 6 <sup>th</sup> column 7 <sup>th</sup> column  1.1 Introductory Biology 11 <sup>th</sup> column 12 <sup>th</sup> column	  100 30  60 20	  Change to 80 Delete  Change to 80 Delete	  80 Nil  Read as 80 Nil
7	Table II 2.7	Photophysiology and Toxicology	Change "Photo" to "Patho"	Pathophysiology and Toxicology
7	Table II 3.3 to 4.8 12 <sup>th</sup> column	  20	Delete	Nil
42	Title No. 6	Pharmacology of drugs acting on CNS	Change 'C' to "A"	Pharmacology of drugs acting on ANS
44	Item 2.7 Sl.No.4	Pathologogenesis	Delete "lo"	Pathogenesis



# RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, BANGALORE

## SCHEDULE TO THE UNIVERSITY NOTIFICATION ACA/ORD-6/97-98 ORDINANCE FOR THE FOUR -YEAR B. PHARM DEGREE COURSE

### I. Minimum qualification for admission to the course

1. Candidate who have passed the two year P.U.C. examination of Karnataka P.U.C Board or an equivalent examination of any other approved Board or university with minimum 50% marks in any combination comprising P.C.M or P.C.B (minimum eligibility should be based on the aggregate of P.C.M. or P.C.B) or P.C.M.B.

**Note:** *In respect of candidates who have taken P.C.M.B. combination the aggregate of P.C.M.or P.C.B whichever is higher shall be considered for the purpose of admission.*

2. In the case of students belonging to SC/ST, group-A the minimum requirement in percentage of marks for the admission to B.Pharm course shall be 40%in combination

OR

3. Final D.Pharm examination conducted by an authority approved by the pharmacy council of india with a minimum of 50% of aggregate marks in all subjects of Final D.Pharm.

**Note:** *A candidate who has passed one year D.pharm after his/her P.U.C. the marks obtained in Human Anatomy, Physiology & Heath Education prescribed by ER 1981 of Pharmacy Council of India shall not be considered for aggregate for the purpose of admission.*

### II. Duration of the course

The course of study for B.Pharm shall extend over a period of four academic years.The curricula and syllabi for the course shall be prescribed from time to time.

### III Medium of instructions

Medium of instructions shall be English

### IV. Attendance

A candidate is required to put in atleast 75% attendance in theory and practical subjects separately in a recognised institution approved by and affiliated to RGUHS. The candidate shall complete the prescribed course satisfactorily to be eligible for appearing for the examination .

## **V Course of study**

The course of study for B.Pharm I, II, III and Final year shall include the respective theory and practical subjects as given in Table I. The number of hours to be devoted to each theory and practical subject in an academic year shall not be less than that noted in column 2 and 3

## **VI Approval of institution conducting the course of study**

The regular course for B.Pharm I, II, III and IVth year under clause 4 shall be conducted by an institution approved and affiliated to Health University. The approval and affiliation will be granted only if adequate arrangements for teaching in regard to building, accommodation, equipment, chemicals, glass-ware, library and teaching staff as specified in appendix are provided.

## **VII Academic Work**

A regular record of attendance both in Theory and Practicals shall be maintained by the teaching staff.

### **INTERNAL ASSESSMENT MARKS**

#### **A. Theory**

Three sessional examinations (evenly spaced) shall be conducted during the academic year by the affiliated colleges. The average marks of best two examinations shall be computed out of a maximum of 20 marks and shall constitute the sessional award in theory.

Provided further the colleges may conduct one special theory sessional examination towards the end of the academic session for those who might have missed any one of the regular sessional examinations. For special theory examination the portion prescribed shall be the entire syllabus of the subject.

#### **B. Practicals**

Students are expected to perform the number of experiments listed in respective syllabi. Marks shall be awarded out of a maximum of 10 to each of the practical exercise and an average of those shall be computed out of a maximum of 20 marks. This shall constitute the sessional award in practicals. While awarding the sessional marks for practicals experiments, following consideration should be taken into account.

- 1) Preparedness of the Candidate
- 2) Manipulative skill
- 3) Results
- 4) Knowledge of the experiments and
- 5) Viva Voce.

A regular record of both theory and practical class work and sessional examinations conducted in an institution imparting the courses shall be maintained for each student in the institution. Marks shall be awarded as per the schemes given in Table No. II.



## VIII Examinations

There will be four examinations namely, First Year, Second Year, Third year and Final Year B.Pharm examination. The details regarding the duration of papers, maximum marks for each paper including the sessional marks allotted to each subject is given in Table No.II.

- IX** (a) Candidates who have secured a minimum of 40 percent in University Theory papers and Practicals separately and 50 percent marks in theory aggregate (University Theory plus viva and Sessional) and Practical aggregate (University Practical plus viva and Sessional) respectively in any subject or subjects shall be declared to have passed in that subjects/s and exempted from appearing at subsequent Examinations.
- (b) Theory and Practicals of a particular subject shall be considered as a single subject.
- X** Conditions under which candidates are permitted to proceed to next higher class:-
- a) Amongst the eight subjects prescribed for I.B.Pharm course there shall be an Examination conducted by the college in respect of the following three subjects:-
- Introductory Mathematics
  - Introductory Biology: Theory and Practicals
  - Computer Science and work assignment
- (b) The candidate shall have 35 percent of the total marks prescribed for a pass and should pass in all the above three subjects to be eligible to appear for university examination in remaining subjects.
- (c) Candidates who have passed in all the subjects prescribed for I B.Pharm course shall be eligible to proceed to II B.Pharm course.
- (d) Any Candidate who fails in three subjects amongst six subjects prescribed for University I.B.Pharm examination is permitted to proceed to II B.Pharm and to appear for the examination in failed subjects of I B.Pharm and complete them successfully before admission to III B.Pharm course.
- (ii) (a) Candidates who pass in all the subjects prescribed for the II B.Pharm examination are eligible to proceed to III B.Pharm course.
- (b) Candidates who have failed in three subjects prescribed for II B.Pharm University examinations are eligible to proceed to III B.Pharm and to appear for the examination in failed subjects of II B.Pharm and complete them successfully before admission to IV B.Pharm course.
- (iii) Candidates who have passed all the subjects of III B.Pharm are eligible to proceed to IV B.Pharm. Candidates who have failed in three subjects of III B.Pharm are eligible



to proceed to IV B.Pharm but have to pass all the subjects of III B.Pharm before the announcement of IV B.Pharm examination results.

#### **XI. Improvement of Sessional marks**

Candidates who wish to improve the sessional marks only in theory subjects can do so appearing in the special sessional examination/s conducted by the college. A Minimum of two and maximum of three resessional examination/s shall be conducted by the college out of which the average marks of the best two of the three special sessional examination shall be forwarded to the university at least 15 days prior to the commencement the next university examination. No candidate is eligible for any more resessional examination in a particular subject. If in the resessional examination the performance is not better than his/her previous regular sessional examination/s then only the marks of the regular sessional examination/s shall be forwarded to the university indicating his/her appearance in resessional examination/s in particular subject/s atleast 15 days prior to the commencement of next university examination.

**XII** Class shall be awarded at the end of I,II,III and Final year of B.Pharm examination as shown below.

1) Distinction	...	75% and above
2) First Class	...	60% and above
3) Second Class	...	50% and above and less than 60%

Pass class shall be awarded to such of the candidates who would have passed the examination in more than one attempt. However, this shall not be applicable to candidates who are exempted in Introductory Biology and Introductory Mathematics by the Bangalore RGUHS, Karnataka

**XIII** Every candidate shall undergo practical training in Pharmaceutical Manufacturing House/ Approved Hospital/CSIR Research Labs for a period of not less than one hundred and fifty hours to be covered in not less than one hundred and fifty hours to be covered in not less than one month after completing IV B.Pharm course. Candidate should submit two copies of the training report duly certified by the authorities of the training centre in which he/she has undergone training, duly accented and certified by the Head of the Institution.

#### **XIV Award of Degree**

Degree shall be awarded during the ensuing convocation for successful candidates.

#### **XV Industrial Tour**

Candidates studying in Final Year of the course shall visit several Pharmaceutical manufacturing houses as a supplement to their academic training and submit a report to the satisfaction of the Head of the institution where he/she studied.

#### **XVI Award of Ranks**

Ranks and Medals shall be awarded on the basis of aggregate of all the four university examinations as RGUHS, Karnataka, norms.

However, candidates who fail in one or more subjects during the B.Pharm courses shall not be eligible for award of ranks.

Moreover, the candidates should have completed the B.Pharm course in prescribed (minimum) number of years.



**TABLE -1***(See Clause 4)***Courses of study for B. Pharm.**

Sl. No.	Subject	Theory Hours/week	Practicals Hours/week
<b>1.</b>	<b>First Year B.Pharm</b>		
1.1	Introductory Mathematics or Introductory Biology	2	- 3
1.2	Mathematics	3	-
1.3	Physical Pharmacy-I	2	3
1.4	Human Anatomy and Physiology and Health Education	3	3
1.5	Pharmaceutics	2	3
1.6	Pharmaceutical Organic Chemistry - I	3	3
1.7	Pharmaceutical Inorganic Chemistry	2	3
1.8	Computer Science with work assignment	1	2
	Total No. of Hours per week	<b>16/20</b>	<b>15/20</b>
<b>2.</b>	<b>Second Year B.Pharm</b>		
2.1	Pharmaceutical Organic Chemistry -II	2	3
2.2	Applied Biochemistry	2	3
2.3	Pharmaceutical Analysis	2	3
2.4	Pharmaceutical Microbiology	2	3
2.5	Physical Pharmacy - II	2	3
2.6	Pharmacology - I	3	3
2.7	Pathophysiology and Toxicology	2	
	Total No. of Hours per week	<b>15</b>	<b>18</b>
<b>3.</b>	<b>Third Year B.Pharm</b>		
3.1	Medicinal Chemistry - I	3	3
3.2	Pharmaceutical Engineering	3	3
3.3	Pharmacology - II	2	3
3.4	Pharmaceutical Biotechnology	2	3
3.5	Pharmacognosy and Phytochemistry - I	2	3
3.6	Dispensing and Formulative Pharmacy	3	3
	Total No. of Hours per week	<b>15</b>	<b>18</b>
<b>4.</b>	<b>Fourth Year B.Pharm</b>		
4.1	Medicinal Chemistry - II	2	3
4.2	Manufacturing Pharmacy including Cosmetics	3	3
4.3	Biopharmaceutics and Pharmacokinetics	2	-
4.4	Instrumental Methods of Analysis	2	3
4.5	Pharmacognosy and Phytochemistry - II	3	3
4.6	Pharmaceutical Marketing	2	-
4.7	Hospital and Clinical Pharmacy	2	3
4.8	Pharmaceutical Jurisprudence	2	-
	Total No. of Hours per week	<b>18</b>	<b>15</b>

**TABLE II**  
(See Regulation 5)

Code Subject No.	Theory				Practical			
	No. of papers	Dura- tion of papers (Hrs)	Sessional Maximum Marks for written papers	Theory Viva	Total	Dura- tion of Exami- nation (Hrs)	Sessional Maximum Marks	Max.Marks for Practical Exami- nation voce examn.
								Max. Marks for Viva voce examn.
								Total
								Grand Total
<b>Scheme of Study and Examination for First Year B. Pharm Course</b>								
1.1.1	Introductory Mathematics or Introductory Biology	1	3	20	100	30	100	-
1.2	Mathematics	1	3	20	80	4	20	20
1.3	Physical Pharmacy - I	1	3	20	80	-	-	-
1.4	Human Anatomy and Physiology and Health Education	1	3	20	100	4	20	20
1.5	Pharmaceutics	1	3	20	100	4	20	20
1.6	Pharmaceutical Organic Chemistry - I	1	3	20	100	4	20	20
1.7	Pharmaceutical Inorganic Chemistry	1	3	20	100	4	20	20
*1.8	Computer Science with Work Assignment	1	3	20	80	-	-	-
2.1	Pharmaceutical Organic Chemistry - II	1	3	20	100	4	20	20
2.2	Applied Biochemistry	1	3	20	100	4	20	20
2.3	Pharmaceutical Analysis	1	3	20	100	4	20	20
2.4	Pharmaceutical Microbiology	1	3	20	100	4	20	20
<b>Scheme of Study and Examination for Second Year B. Pharm Course</b>								
2.1	Pharmaceutical Organic Chemistry - II	1	3	20	100	4	20	20
2.2	Applied Biochemistry	1	3	20	100	4	20	20
2.3	Pharmaceutical Analysis	1	3	20	100	4	20	20
2.4	Pharmaceutical Microbiology	1	3	20	100	4	20	20



2.5	Physical Pharmacy - II	1	3	20	100	30	150	4	20	80	-	100	250
2.6	Pharmacology - I	1	3	20	100	30	150	4	20	80	-	100	250
2.7	Photophysiology and Toxicology	1	3	20	100	30	150	-	-	-	-	-	150

### Scheme of Study and Examination for Third Year B. Pharm Course

3.1	Medicinal Chemistry - I	1	3	20	100	30	150	4	20	80	-	100	250
3.2	Pharmaceutical Engineering	1	3	20	100	30	150	-	-	-	-	-	150
3.3	Pharmacology - II	1	3	20	100	30	150	4	20	80	20	100	250
3.4	Pharmaceutical Biotechnology	1	3	20	100	30	150	4	20	80	20	100	250
3.5	Pharmacognosy and Phytochemistry - I	1	3	20	100	30	150	4	20	80	20	100	250
3.6	Dispensing and Formulative Pharmacy	1	3	20	100	30	150	4	20	80	20	100	250

### Scheme of Study and Examination for Fourth Year B. Pharm Course

4.1	Medical Chemistry - II	1	3	20	100	30	150	4	20	80	20	100	250
4.2	Manufacturing Pharmacy	1	3	20	100	30	150	4	20	80	20	100	250
4.3	Biopharmaceutics of Pharmacokinetics	1	3	20	100	30	150	-	-	-	-	-	150
4.4	Instrumental methods of Analysis	1	3	20	100	30	150	4	20	80	20	100	250
4.5	Pharmacognosy and Phytochemistry - II	1	3	20	100	30	150	4	20	80	20	100	250
4.6	Pharmaceutical Marketing	1	3	20	100	30	150	-	-	-	-	-	150
4.7	Hospital and Clinical Pharmacy	1	3	20	100	30	150	4	20	80	20	100	250
4.8	Pharmaceutical Jurisprudence	1	3	20	100	30	150	-	-	-	-	-	150

\* Class examination, minimum for pass is 35% marks does not counts for declaration of Class/Rank.

# I YEAR B. PHARM

## 1.1 INTRODUCTORY BIOLOGY

### Part A : Botany

1. General organisation of the plant and its inclusions.
2. The plant tissues (Meristematic and permanent).
3. The broad classification of the plant kingdom.
4. Morphology of the plant parts like roots, stem, leaf and their modifications.
5. Inflorescence and flower, its pollinations.
6. Morphology of fruits and seeds.
7. Plant Taxonomy: Families 1) Leguminosae, Umbelliferae. Solanaceae, Liliaceae, Zingiberaceae, Rubiaceae with special reference to medicinal plants.
8. Plant physiology : Transpiration, Photosynthesis, Respiration, Growth and plant nutrition, vitamins, enzymes.
9. The study of the Root and Fungi, Yeast, Penicillin, Bacteria.

### Part B: Zoology

1. The study of Animal cell, Animal tissues, differences between Plant cell and Animal cell.
2. The detailed study of frog.
3. The study of representatives of the Pisces, Reptiles, Aves with special reference to their medicinal values.
4. General organisation of a mammal.
5. The study of Poisonous animals.

## PRACTICALS

### Part A : Botany

1. The general organisation of a typical plant and morphological study of plant parts studied in theory (Roots, Stem, leaves and their modifications)
2. Inflorescence and flower.
3. Fruits and seeds (Identifications).
4. Plant tissues through permanent slides and Histological preparations of Roots,



Stems and Leaves by Eosin or Saphronine stain.

5. Simple experiments on plant physiology.
6. Identifications of representatives of Animals Phyla like fish, frog, reptile and mammal.

## REFERENCE BOOKS

- |                                      |   |
|--------------------------------------|---|
| 1. A class book of Botany            | - A C Dutta                                 |
| 2. Outlines of Zoology               | - Ekambarnath Iyer and T.N. Anantha Krishna |
| 3. Functional Anatomy of a mammal    | - Tayler and Weber                          |
| 4. Comparative Anatomy               | - Atwood.                                   |
| 5. Baleys Text Book of Histology     | - W.M. Copenhaver                           |
| 6. A Text Book of Vertebrate Zoology | - S.N. Prasad                               |
| 7. Vertebrate Zoology Vol. II        | - Ekambernath Iyer                          |

## 1.1 INTRODUCTORY MATHEMATICS

### Part I : Algebra

#### 1. *Theory of Indices*

Definition of an index, Laws of indices (without proof) - Examples.

#### 2. *Surds*

Definition and laws of surds, square roots and fourth roots of binomial surds, square root of trinomial surds - examples.

#### 3. *Logarithms*

Definition and properties of logarithm, use of logarithmic tables - examples.

#### 4. *Theory of Quadratic Equations*

Solution and nature of the roots of the quadratic equation :  $ax^2 + bx + c = 0$ , relation between the roots and the coefficients of the quadratic equation. Formation of the quadratic equation with given roots - examples.

#### 5. *Progressions*

A.P., G.P., H.P., sum to n terms of AP and GP, theorem on means:  $G^2 = AH$  and  $A > G > H$  - examples.

#### 6. *Permutations and Combinations*

Definitions, Expressions for npr and ncr - simple examples.

7. *Binomial Theorem*

Statement of Binomial theorem (without proof), examples on finding middle term, constant term etc.

8. *Partial Fractions*

Proper and improper fractions, rules of resolving into partial fractions - examples.

9. *Determinants and Matrices*

Determinants of order two and three, properties of determinants (without proof) simple examples.

Definition of matrix, addition, subtraction and multiplication of matrices, transpose of a matrix - simple examples.

## **Part II : Analytical Geometry**

1. *Point*

Cartesian co-ordinate system in a plane, point, distance formula, section formula, area of a triangle, centroid of a triangle, concept of locus.

2. *The straight line*

Slope of a line, various standard forms of a line, condition for two lines to be parallel and perpendicular to each other, angle between two lines, Equation of a straight line passing through the point of intersection of two lines - examples.

3. *The circle*

Definition, general equation of a circle;  $x^2+y^2+2gx+2fy+c=0$  and find its centre and radius, Equation of tangent to the circle - examples.

## **Part III : Trigonometry**

1. Measurement of angles, trigonometrical ratios and relations connecting them, values of trigonometrical functions of standard angles, trigonometrical functions of allied angles, trigonometrical function of compound angles, multiple angles and sub-multiple angles, transformation formulas from product into sum or difference and from sum or difference into product-identities.
2. Relations between - the sides and the trigonometrical functions of the angles of a triangle, the Sine Rule, Cosine Rule,  $a=b \cos C + c \cos B$ . General solution of trigonometrical equations - only simple cases. Solution of triangles - simple cases without using log tables, inverse trigonometrical functions - examples .



## Part IV : Calculus

Definition of limit of a function - examples, derivatives of a function, differentiation of a sum, product and quotient of two functions. Differentiation of trigonometric, inverse- trigonometric, logarithmic, exponential, implicit, composite and parametric functions.

### REFERENCE BOOKS

1. A Text Book of Mathematics for First year Pre-University  
- Prof. B.M. Sreenivasa Rao, S. Nagaraj.
2. A Text Book of Mathematics for Second year Pre-University  
- Prof. B.M. Sreenivasa Rao, S. Nagaraj.
3. A Text Book of Pre-University Mathematics Vol. - I and Vol - II  
- K.A. Krishnamurthy, V. Venkataraman Rao.
4. Trigonometry - Part I and Part II - S.L. Loney.
5. Differential Calculus - Shantinayakan.

### 1.2 MATHEMATICS

#### 1. *Differential Calculus*

Successive differentiation, Leibnitz's theorem for finding  $n^{\text{th}}$  derivative of a product, Expansion of functions applying. Maclaurin's theorem, only simple examples. Partial differentiation, total differential coefficient of  $u$  where  $u = f(x, y)$  Euler's theorem on homogeneous functions of two variables:

$$x \frac{\delta u}{\delta x} + y \frac{\delta u}{\delta y} = nu, \text{ simple examples.}$$

#### 2. *Integral Calculus*

Integration : Method of substitution, Integration of rational, irrational, algebraic functions, trigonometrical functions, integration by parts, definite integrals, properties of definite integrals, definite integrals as the limit of a sum. Evaluation of area and volume in simple cases using integration.

#### 3. *Differential Equations*

Formation of a differential equation, Differential equations of the first order and first degree: (1) Variable separable (2) Homogeneous differential equations and equations reducible to homogeneous form (3) Linear form (4) Exact differential equations.

Linear differential equations with constant coefficients (higher order), homogeneous

linear differential equations (first method of solution only), simultaneous differential equations which are linear and of the first order.

#### 4. *Laplace Transforms*

Definition, Laplace transforms of a sum, difference, derivatives and integrals (without proof), Inverse Laplace transforms of standard functions, simple examples. Solutions of ordinary differential equations of the first and second orders using Laplace transforms.

#### 5. *Matrices*

Inverse of a square matrix, solution of linear equations by matrix method, rank of a matrix, elementary transformations of matrices, reduction to normal form. The characteristic equation of a matrix, Cayley - Hamilton theorem, Eigen values and Eigen vectors of a square matrix.

#### 6. *Statistics*

- a) Frequency distribution, graphical representation of the data: Histogram, Frequency curve and Frequency polygon, Ogive, Semi logarithmic line graph, use of semi logarithmic scale.
- b) Measures of central tendency: mean, mode and median, quartiles, deciles and percentiles.
- c) Measures of dispersion: Range, Quartile deviation, Mean - deviation, Standard deviation, variance, Coefficient of variation, Coefficient of skewness.
- d) Curve fitting by method of least squares: Linear equations only.
- e) Correlation and Regression: Linear correlation, Coefficient of correlation: Karl Pearson's formula and rank method, Regression lines: Regression equation of y on x and x on y, standard error of estimates.
- f) Definition of probability, Addition and multiplication laws of probability (without proof), concept of sampling. Meaning of the terms: sample, population, parameter, statistic, statistical hypothesis, level of significance, degrees of freedom, Type I error and Type II error.

### REFERENCE BOOKS

- |  |                                  |
|--|----------------------------------|
| 1. Differential Calculus                 | - Shantinarayan                  |
| 2. Integral Calculus                     | - Shantinarayan                  |
| 3. Engineering Mathematics               | - Grewal                         |
| 4. A Text Book of Integral Calculus      | - H.C. Sinha                     |
| 5. A Text Book of Differential Equations | - H.C. Sinha and B. Johri        |
| 6. Mathematical Statistics               | - Kapur and Saxena               |
| 7. Fundamentals of Statistics            | - S.C. Gupta                     |
| 8. Practical problems in statistics      | - D.N. Elhance and Veena Elhance |



## 1.3 PHYSICAL PHARMACY - I

### 1. *Intermolecular Forces*

Repulsive forces and Attractive forces - Dipole - Dipole, Ion - Dipole, Dipole - Induced Dipole Interactions.

### 2. *Chemical Bonding*

a) Ionic Bonding b) Covalent Bonding, c) Co-ordinate Bonding, d) Hydrogen Bonding, e) Vander - Waals forces, f) Valence Bond theory and g) Molecular Orbital Theory.

### 3. *Physical Properties and Chemical Constitution*

Additive and Constitutive properties: Molar volume, Surface Tension and its determination, Parachor, Viscosity and its determination, Refractive Index and its determination, Molar Refraction, Optical Activity and its Measurement, Optical Rotation, Dipole moments and Dielectric constant. Dipole moment of drug molecules.

### 4. *Gases : Kinetic Molecular Theory*

Postulates and the derivation of Gas laws, ideal gas equation, Vander - Waal's Equation, Ratio of Specific Heats of Gases. Critical Phenomena: Critical constants, Liquefaction of Gases and Aerosols.

### 5. *Solid State : Elements of Symmetry - Crystalline state: Elements of Symmetry, Miller's Indices, Crystal systems, Crystal structure: Bragg's Law - its derivation and Applications. Polymorphism, Dilatometric analysis of pharmaceutical fats and waxes.*

### 6. *Thermodynamics : Definition of various terms used in Thermodynamics, Reversible and Ir-reversible processes, Interconversion of heat and work.*

### 7. *First law of Thermodynamics : Concept of Internal Energy, work done in Adiabatic and Isothermal expansion of an Ideal Gas. State Functions, exact or perfect differentials, Thermodynamic Criteria of an ideal gas.*

### 8. *Enthalpy: Concept of Enthalpy (H), heat capacity of Gases at constant volume and constant pressure and relationship between them. Kirchhoff's equation and its applications.*

### 9. *Second Law of Thermodynamics : Statement in different forms, Carnot Cycle and the Concept of entropy (S). Work function (A) and free energy (G): Their concepts, variation of free energy with pressure and temperature. Gibbs - Helmholtz equation, Free Energy change and its applications. Clausius - Clapeyron equation and its applications.*

### 10. *Phase Rule : The phase rule and explanation of the terms, application to Water, Sulphur, Sodium chloride - water systems.*

11. *Solubility and Distribution Phenomenon*: Solubility of gases in liquids: Henry's Law and its applications.

*Solubility of liquids in liquids*: Completely Miscible liquids; Vapour pressure - composition and Boiling Point - Composition Curves of completely Miscible liquids, Azeotropic Mixtures, Fractional distillation, Partially miscible liquids: Critical solution temperature, phenol - water system, Triethylamine water and Nicotine - water systems.

12. *Completely immiscible Liquids* : Steam Distillation, Aniline - water or Chlorobenzene - Water systems.

*Solubility of solids in liquids* : Solubility, Definition; its determination, Variation of solubility with temperature and pressure.

13. Distribution Law and its Applications

14. *Electro Chemistry* : Electrolytic conductance, equivalent and Molar Conductance and their experimental determination. Variation of equivalent conductance with dilution or concentration. Strong and weak Electrolytes and Debye - Huckle Theory, Ionic strength, and Activity co-efficient, Debye - Huckle limiting law.

Transport Number and its Determination - Kohlrausch's Law and its Applications, Relationship between Transport number and conductance.

Ostwald's Dilution Law and its applications, Ionic product of water, pH, - pHscale, methods of determination of pH. Buffers, Buffer action, Henderson - Hasselbach Equation, Buffer Capacity, Buffer systems used in pharmacy.

*Modern Theory of Acids and Bases* : Acid - Base equilibria. Hydrolysis of salts of various types, Relation between  $K_h$ ,  $K_a$ ,  $K_b$  &  $K_w$ .

15. *Photo Chemistry*: Laws of photo chemistry and their applications in colorimetry - Lambert - Beers law and its application, Quantum efficiency.

*Secondary photo - Chemical processes* : Fluorescence, phosphorescence, Luminescence and photosentization, photosynthesis.

16. *Radio Activity* : Natural Radio Activity : Nature and characteristics of radiations from Radio Active substances. Measurement of Radio activity. Theory of Radio active emission and disintegration, Artificial Radio Activity, Isotopes and their applications in medicine, Pharmacy and other fields. Nuclear Fission and Fusion.

17. *Chemical spectroscopy* : Electromagnetic Spectrum and its interactions with matter. Types of spectra : Rotation, Vibration - Rotational Spectra, Determination of Molecular parameters, such as force constant and bond length, Brief account of UV-Visible, I.R. Raman, NMR and ESR spectra.



### 1.3 PHYSICAL PHARMACY - I (PRACTICALS)

1. Determination of Density of liquids by using Density Bottle or pycnometer.
2. Determination of Specific gravity and weight per ml factor of liquids by using specific gravity bottle/pycnometer.
3. Determination of Viscosity of pure liquids by Ostwald's Viscometer at room temperature.
4. Determination of relative viscosity of mixtures of alcohol and water at room temperature by using Ostwald's Viscometer.
5. Determination of the surface tension of pure liquids by using stalagmometer.
6. Determination of Refractive Index of a liquid and variation of the Refractive Index with composition of mixtures and calculate the percentage composition using Refractometer.
7. Determination of partition co-efficient of Benzoic Acid between Benzene and water.
8. Determination of Distribution co-efficient of Iodine between water and Carbon tetrachloride.
9. Determination of dissociation constant of Triiodide ion by distribution method.
10. Determination of Heat of Neutralisation of strong Acid with strong base.
11. Determination of Molar Heat of solution of a solid.
12. Determination of Heat (Molar) of Dilution.
13. Determination of Molecular weight of a non-volatile substance by Ebullioscopic Method.
14. Determination of Molecular weight of a substance by depression in freezing point method by using Beckmann Thermometer.
15. To determine the concentration of the given solution of sodium chloride using phenol - water system.
16. Determination of solubilities of three liquids co-existing together (i.e. co-solvent effect).
17. Determination of pka values of the given weak acids (Acetic Acid) by Indicator method. Preparation of buffers and Colorimetric calculations of pH and Pka values.
18. Determination of solubilities of Solids at room temperature at different temperatures.
19. Determination of Specific molecular rotation of sugar solution by using polarimeter (Composition of sugar in the given solution).
20. Effect of a salt on the solubility of phenol in water and the change in the miscibility temperature.
21. Transition temperature of a salt hydrate by thermometric method.

### REFERENCE BOOKS

- |                                    |                     |
|------------------------------------|---------------------|
| 1. Text book of Physical Chemistry | - S. Glasstone      |
| 2. Physical Chemistry              | - A.J. Mee          |
| 3. Physical Chemistry              | - Gordon. M. Barrow |
| 4. Physical Chemistry              | - Walter J. Moore   |
| 5. Chemistry                       | - Michell J. Sieuko |
| 6. Physical Pharmacy               | - Martin.           |

## 1.4 HUMAN ANATOMY, PHYSIOLOGY AND HEALTH EDUCATION

- I. a) General principles of Human physiology, physiochemical properties transport functions of cell membranes.
- b) Study of elementary tissues.
- c) Excitation, conduction and transmission of nerve impulse.
- d) Excitation and contraction of muscles.

### II. PHYSIOLOGY OF BLOOD AND LYMPH

- a) Composition and General properties
- b) Haemopoiesis,
- c) Erythrocytes and Haemoglobin
- d) WBC and platelets
- e) Blood coagulation
- f) Blood groups and transfusion
- g) Haemolysis and suspension stability of blood
- h) Lymph and tissue fluids
- i) Regulation of (H<sup>+</sup>) of body fluids
- j) Fluid distribution and exchange

- III. Gross anatomy of the following systems cardiovascular, Nervous, Muscular, Digestive, Respiratory, Urine, Genital, Endocrine and special senses skeletal system. Histology of elementary tissues and major organs in the above mentioned systems

**Note :** *Gross anatomy and microscopic anatomy of organs concerned should be taught under each system which will help in understanding physiology.*

Gross anatomy should include location, shape, size, colour, weight, nerve supply, blood supply and organs in association with it.

### IV. CENTRAL NERVOUS SYSTEM

- 1) Spinal cord and its relationship with higher part of the CNS: Characteristics of Reflex.
- 2) Central hemispheres, functions of cerebral cortex, Cerebellum, Medulla oblongata, Basal Ganglia, Thalamus, Hypothalamus.
- 3) Autonomic Nervous System.
- 4) The nerve mechanism of sensation in vision, hearing, speech, smell, taste and cutaneous sensation, heat balance.



## **V. CARDIOVASCULAR SYSTEM**

- 1) The heart, Gross structure, Myocardial cells
- 2) Electrophysiology of heart
- 3) Mechanical activity of the heart
- 4) Regulation of the heart
- 5) Coronary circulation
- 6) Measurement of Blood Pressures and flow
- 7) Control mechanisms of the circulatory system
- 8) Regulation of systemic and pulmonary circulation
- 9) Blood circulation to brain, Skin, skeletal system spleen and kidney.

## **VI. RESPIRATORY SYSTEM**

- 1) Uptake and delivery of respiratory gases
- 2) Pulmonary gas exchange
- 3) Mechanics of breathing
- 4) Control of Breathing
- 5) Hypoxia, Asphyxia, Dysbarism, Oxygen therapy and Resuscitation.

## **VII. URINARY SYSTEM**

- 1) Urine formation
- 2) Physiology of Kidney and Micturition
- 3) Plasma clearance, Insulin, Urea, Diodone Clearance.
- 4) Gross anatomy and physiology of reproductive system including pregnancy tests.

## **VIII. DIGESTIVE SYSTEM**

- 1) Control of food and water
- 2) Innervation and visceral sensation of the GIT
- 3) Gastro intestinal hormones
- 4) Salivary, gastric, pancreatic, Intestinal and Biliary secretions
- 5) Digestion and absorption of foods
- 6) Movements of the alimentary canal
- 7) Balanced diet and Nutrition

## **IX. ENDOCRINE SYSTEM**

- 1) Introduction to endocrine control systems
- 2) Anatomy and physiology of endocrine glands:

## **X SPORTS PHYSIOLOGY**

- 1) Muscles in exercise
- 2) Effect of athletic training on muscles and muscle performance
- 3) Respiration in exercise
- 4) Cardiovascular system in exercise
- 5) Body Heat and exercise
- 6) Body fluids and salt in exercise.
- 7) Drugs and athletics

## **XI Aviation, high altitude and space physiology**

## **XII Reproductive System**

**XIII** Concept of Health, factors affecting health, Family Planning methods and their mechanisms, Family planning, Role of Pharmacist in family planning.

## **PRACTICALS**

1. Study of appliances used in experimental physiology
2. Determination haemoglobin content of blood
3. Determination of R.B.C. content of blood
4. Determination W.B.C. content of blood
5. Determination of Platelet content of blood
6. Determination of differential leucocyte count of blood
7. Determination of blood groups
8. Determination of blood pressure
9. Determination of Bleeding time and clotting time, Fragility, ESR.
10. Determination of vital capacity
11. To record muscle curve using gastrocnemius sciatic nerve preparation
12. To record summation curve using gastrocnemius sciatic nerve preparation
13. To record effect of temperature using gastrocnemius sciatic nerve preparation
14. To record effect of load and after load using gastrocnemius sciatic nerve preparation
15. To record fatigue curves using gastrocnemius sciatic nerve preparation
16. Study of various models, specimen, bones
17. Study of histological slides of different tissues/organs
18. Study of different family planning appliances
19. To perform pregnancy diagnosis tests.



## REFERENCE BOOKS

- |   |   |
|---|---|
| 1. Principles of Anatomy & Physiology     | - Gerard J Tortora, Nicholas P Anagnostaxo<br>Pub. Harper with Row publishers, New York |
| 2. Illustrated Physiology                 | - ABMC Naught/Callander R   |
| 3. Samsan Wright Applied Zoology          | - Cakeele and E Nol.  |
| 4. Anatomy and Physiology                 | - Kimber, Grey, Stacktole's   |
| 5. Text book of Medical Physiology        | - Arthur C. Guyton  |
| 6. Human Physiology : Vol. I & II         | - Dr. D.C. Chatterjee   |
| 7. Concised Medical Physiology            | - Chowdhary   |
| 8. Principles of Anatomy and Physiology   | - Ross and Wilson   |
| 9. Preventive and Social Medicine         | - Park and Park   |
| 10. Practical Physiology and Biochemistry | - Goel Shah and Patel   |
| 11. Experimental Physiology               | - Ranade  |
| 12. Experimental Physiology               | - Anderson  |
| 13. Experimental Physiology               | - Apte  |

## 1.5 PHARMACEUTICS

1. Historical background and development of profession of pharmacy and pharmaceutical industry in brief in the world, in specific in India.
2. Development of India pharmacopoeia and introduction to other pharmacopoeias such as BP, USP, European pharmacopoeia, International pharmacopoeia, Extra Pharmacopoeia.
3. Introduction to Dosage forms, classification and definition
4. Different types of weights and measures. Pharmaceutical Arithmetic Calculation of percentage of solutions, allegation and proof spirit.
5. Heat process : Introduction to different types like Fusion, Desiccation, Sublimation, Exciccation, Ignition various types of baths.
6. Different types of solvents and their uses in Pharmacy.
7. Size Reduction : Definition, Advantages, Disadvantages, different methods, grading of powders, official grades sieves used for separation. Theory of communiton and factors affecting size reduction, application of size reduction.  
  
Factors affecting size reduction. Study of Hammer mill, Ball mill, Fluid energy mill, Colloidal mill, Selection of mill, Edge runner, End runner, Triple roller mill (Construction and working)
8. Emulsions, Suspensions and Colloids : Definition, types, methods for preparation of official preparation thereof.

9. Galenicals : Definition, Equipments for different extraction process like infusion, decoction, maceration, percolation and galenical preparation, spirits; tinctures: extracts, expression, Method or preparation and their uses.
10. Surgical aids : Surgical dressings, surgical cotton, sutures, ligatures medicated bandages catgut preparations, sterilisation, official standards.
11. Dermatological preparations like Liniments, Lotions, Creams, Ointments, Paste, Poultice; Definition and official preparations thereof.
12. Official preparations like Solution, Aromatic Waters, Glycerins, Syrups, Elixirs.
13. Different process involved in preparation of official preparation, like Evaporation, Distillation, Filtration, Saponification to be discussed in brief.
14. Different methods of storage conditions, preservation, organoleptic addition, antioxidants in brief to be discussed with relation to official preparations.
15. Selection of containers, Closures, Packing materials, labelling regimens to be discussed for official preparations.

## PRACTICALS

1. Preparation of official products based on above mentioned process.
2. *Aromatic Water* : Chloroform water IP, Camphor water IP, concentrated Dill water IP, concentrated peppermint water BP, cinnamon water IP, Rose-water USP.
3. *Glycerines* : Glycerin of Borax IP, Glycerin of Tannic Acid IP, Glycerin Thymol compound BPC, glycerin of Starch IP.
4. *Syrups* : Simple syrup IP, Syrup Ephedrine hydrochloride NF, Syrup Vasaka IP, Syrup of Ferrous Sulphate IP, Syrup Orange IP, Syrup Lemon IP.
5. *Elixir* : Piperazine citrate elixir BP, Cascara Elixir BPC, Paracetamol Elixir (Paediatric) BPC.
6. *Linctus* : Simple Linctus BPC simple Linctus (Paediatric) BPC Codein Linctus BPC
7. *Solutions* : Solution of Cresol with soap, IP, Strong - Solution of Ferric Chloride BPC, Solution of Gentian Violet USP, Aqueous Iodine solution IP, strong - solution of Iodine IP, Strong solution of Ammonium acetate IP, Aromatic spirit of Ammonia.
8. *Liniments* : Liniment of Turpentine IP, Liniment of Camphor IP.
9. *Suspensions* : Calamine Lotion IP, Magnesium Hydroxide mixture BP Kaolin poultice; pain balms.

## REFERENCE BOOKS

1. Introduction to pharmaceutical Dosage forms - *Lea and Febiger*
2. Bentley's Text Book of Pharmaceutics - *E.A. Rawlins*
3. Remingtons Pharmaceutical Sciences - *Martin (Mack)*
4. I.P.
5. B.P.
6. B.P.C.
7. U.S.P.



## 1.6 PHARMACEUTICAL ORGANIC CHEMISTRY - I

**Note :** The subject will be treated in the modern perspective keeping the general classification of organic compounds laying emphasis on structure, nomenclature, properties, stereochemistry etc.

### 1. *Scope of pharmaceutical organic chemistry*

Atomic orbitals, Molecular orbitals, ionic bond - Multiple bond, Covalent bond,  $sp^1$ ,  $sp^2$ ,  $sp^3$  orbitals. Polarity of bonds, Intermolecular forces. Hydrogen bond.

### 2. *Alkanes : Nomenclature.*

Structure of Methane, reactions of methane, Oxidation. Heat of combustion, Chlorination, Substitution reaction, Reaction mechanism.

Structure of ethane, reactions, Halogenation, Mechanism of Halogenation.

Free Radicals, substitution, stability of free radicals, combustion, pyrolysis, official compounds of paraffin; preparation, test for purity, assay of light liquid paraffin, liquid paraffin, white soft paraffin, hard paraffin, yellow soft paraffin.

### 3. *Alkyl halides*

Nucleophilic aliphatic substitution. Homolytic and heterolytic fission. Preparation of alkyl halides. Reaction of alkyl halides. Nucleophilic aliphatic substitution.  $SN_2$  and  $SN_1$  reactions, mechanism, Kinetics, Stereochemistry i.e., inversion of configuration, preparation, test for purity, assay and medicinal uses of ethyl chloride, chloroform, trichloroethylene, tetrachloro ethylene.

Carbocations - Relative stability of carbocations, rearrangement of carbocations,  $SN_2$  Vs.  $SN_1$

### 4. *Alkenes and Alkynes*

Structure of - ethylene, preparation of alkenes; dehydrohalogenation of alkyl halides, i.e., 1-2, elimination. The  $E_2$  &  $E_1$  mechanism. Evidence for  $E_1$  and  $E_2$  mechanisms.  $E_2$  Vs.  $E_1$  Elimination Vs substitution. Reaction of alkenes, heat of hydrogenation, stability of alkene. Electrophilic addition mechanism - rearrangement. Orientation and reactivity.

Alkynes - Preparation and reactions.

### 5. *Conjugation and Resonance*

The carbon-carbon double bond as substituent, theory of multiple bonds, theory of resonance, Hyper-conjugation. Stability and resonance of conjugated dienes. 1,4 addition.

### 6. *Cycloalkanes*

Nomenclature, preparation, reactions, Bayer's strain theory Diels - Alder's reaction.

7. *Aromaticity : Benzene - Structure of Benzene*

Molecular formula, isomer - numbers, kekule structure. Stability of benzene ring. Reactions of benzene. Heats of hydrogenation and combustion. Carbon-carbon bond lengths in benzene.

Resonance structures of Benzene

Aromatic character - The Huckel ( $4n + 2$ ) pi rule. Electrophilic aromatic substitution.

Effect of substituted groups determination of orientation. Classification substituted groups. Orientation in disubstituted benzene. Mechanism of nitration, sulphonation. Friedal crafts alkylation, halogenation. Theory of orientation.

Discussion of official compounds;

DDT, Saccharin, BHC, (Gammabenzene hexachloride) chloramine-T.

9. *Alcohols*

Preparation and reaction of alcohols. di and Tri hydric alcohol, glycol and glycerol and their synthesis and uses. Preparation and test for purity, assay and medicinal uses of the following pharmacopoeial compounds; ethyl alcohol (Rectified spirit. industrial methylated spirit) chlorbutol, cetostery, alcohol, Benzyl alcohol, Mephensin, glycerol, dimercaprol, propylene glycol, Glyceryl Trinitrate and wool alcohols.

10. *Carboxylic acids, Esters and amides*

General methods of preparation and reactivation of acids, esters and amides, preparation, test for purity, assay and medicinal uses of pharmacopoeial compounds acetic acid, trichloro acetic acid. Lactic acid, Oleic acid, Undecenoic acid, Ethyl oleate, Sodium laurylsulphate. Tartaric acid, citric acid, succinic acid, oxalic acid, benzoic acid, benzyl benzoate, dimethyl phthalate salicylic acid, methyl salicylate, Iopanoic acid, ethyl biscoumar acetate, Balsams, aspirin, pheniodol.

11. *Aldehydes and Ketones*

General methods of preparation and reactions - Ketoenol Tautomerism.

Test for purity, assay and medicinal uses of formaldehyde, paraldehyde, acetone, chloral hydrate, Hexamine, Benzaldehyde, Vanillin.

12. *Aliphatic and Aromatic amines.*

General methods of preparation and reactions of amines ring. Substitution in aromatic amines; synthesis involving diazonium salts. Preparation, test for purity, assay, medicinal uses of ethanolamine, ethylene diomine hydrate, urethanes, urea, carbromal aniline amphetamine, sulphanilamide, accetanilide.



13. General methods of preparation of Reactions phenols; dihydric and trihydric phenols.

Acidity of phenols; preparation, test for purity, assay and medicinal uses of important phenols. Phenol, O,M,P,- Cresols, resorcinol. Acetoacetic ester and malonic acid ester preparation synthesis and uses.

The following name reactions may be discussed with examples at appropriate places Claisen. Reformatsky, Grignard, Diels-Alder, Mannich, Curtius, Rearrangement and Marconikoffs rule, Peroxide effect, Walden inversion, Meerwein - Ponderf's reduction.

### REFERENCE BOOKS

- |  |                      |
|--|----------------------|
| 1. Organic Chemistry                     | - Morrison and Boyd. |
| 2. Text book of Pharmaceutical Chemistry | - Bentley & Drivers  |
| 3. Organic Chemistry                     | - I.L. Finar         |
| 4. Organic Chemistry                     | - Cram and Hammond.  |

### PHARMACEUTICAL ORGANIC CHEMISTRY - I (PRACTICALS)

- I. Identification of Organic Compounds belonging to the following classes by systematic qualitative organic analysis with derivatives.
1. Aromatic Hydrocarbons
  2. Alkyl halides and aryl halides
  3. Carboxylic acids and esters
  4. Alcohols
  6. Amides
  7. Aliphatic and Aromatic amines
  8. Phenol
  9. Carbohydrates
  10. Nitro compounds
- II. Preparation of simple organic compounds involving one step. At least 10 compounds to be synthesised.

### REFERENCE BOOKS

- |   |                     |
|---|---------------------|
| 1. Elementary Practical Organic Chemistry | - A.I. Vogel        |
| 2. Practical Organic Chemistry            | - Mann and Saunders |

## 1.7 PHARMACEUTICAL INORGANIC CHEMISTRY

### I *Introduction*

Discussion of periodic table including conventional periodic classification. grouping properties of elements, basic elemental structure of atom, with special reference to pharmacological and biological activities of the elements.

### 2. *Limit Test*

Sources of impurities in pharmaceuticals, importance of limit test (quantitative and qualitative), general procedure for limit test for chloride, sulphate, iron, arsenic, heavy metals and lead, special procedures in limit test.

### 3. General methods of preparation, properties, test for purity, identification test and storage condition, assays of the pharmaceutical compounds listed in IP belonging to the following categories.

- i) Compounds of oxygen, such as oxygen, nitrous oxide, carbondioxide, water, hydrogen peroxide.
- ii) Gastro intestinal agents, acidifying agents, antacids, protectives and adsorbents, saline cathartics, common acids and alkalies used in pharmacy.
- iii) Major intra and extra-cellular electrolytes, major physiological ions, electrolytes used for replacement therapy, physiological acid-base balances, electrolytic combination therapy.
- iv) Essential trace elements, transition elements, their compounds and applications from as haematinics, mineral supplements.
- v) Inorganic pharmaceuticals used for systematic effects, drugs used primarily for cationic and anionic components.
- vi) Topical agents and dermatological preparations, protectives, antimicrobials, astringents.
- vii) Gases and vapours oxygen therapy anesthetic gases, respiratory stimulants.
- viii) Dental products, dentifrices, anticaries agents.
- ix) Miscellaneous compounds : sclerosing agents, expectorants, emetics, sedatives, poisons and antidotes, pharmaceutical aids included in IP.

### LIST OF IP COMPOUNDS TO BE STUDIED

Aluminium	: Hydroxide gel, dried Al-hydroxide gel, tabs, sulphate, bentonite, Kaolin, Alums
Ammonium	: Chloride
Barium	: Sulphate meal
Boron	: Boric acid, borax



Calcium	: Amino salicylate tabs, carbonate, chloride, gluconate Inj. Dibasic phosphate. Tribasic phosphate.
Ferrous	: Sulphate, tabs, dried Ferrous Sulphate tabs, Gluconate fumarate, tabs.
Lithium	: Carbonate tabs.
Magnesium	: Chloride, carbonate, light/heavy oxide, light/heavy stearate, sulphate, trisilicate, mixture of mag. hydroxide.
Nitric Acid	
Phosphoric	
Acid Potassium	: Bromide, chloride, citrate, iodide, permanganate.
Sodium	: Acid phosphate, acetate, Antimony gluconate, Inj-Aurothiomalates, Inj. benzoate, carbonate, bicarbonate, chloride Inj. compound inj. citrate, hydroxides, lauryl sulphate, Lactate, compound lactate, disodium acid phosphate, salicylates, thiosulphate inj. chloride, oxide, peroxide sterate sulphate, undecenoate

## REFERENCE BOOKS

1. Inorganic Medicinal and Pharmaceutical Chemistry, Leo and Febiger, Philadelphia. - *J.W. Black, E.G. Rooche, T.O. Soino and C.D. Wilson*
2. Modern Inorganic Pharmaceutical Chemistry, John Wiley and Sons, New York. - *C.A. Discher*
3. 'Rogers' Inorganic Pharmaceutical Chemistry, Leo and Febiger, Philadelphia. - *T.O. Scine and C.D. Wilson*
4. 'Bentley and Driver's text book of Pharmaceutical Chemistry, 8th edition, Oxford University press, London. - *L.M. Atherden*
5. Pharmacopoeia of India, Govt. of India, Ministry of Health
6. 'Practical Pharmaceutical Chemistry' Part I, - *A.H. Beckett and J.B. Stenlake*  
The Athlane Press, University of London, London.
7. Concise Inorganic Chemistry - *J.D. Lee*

## INORGANIC PHARMACEUTICAL CHEMISTRY (PRACTICALS)

### 1. Exercise covering the following :

- Limit test for chloride, sulphate, iron, heavy metals, arsenic and lead using official pharmaceutical compounds.
- Tests for purity and monograph analysis of selected pharmaceutical inorganic medicinals.
- Purification exercises comprising crystallisation, volatilisation (sublimation), fractional crystallisation etc.,
- Determination of water of crystallisation, loss on drying, sulfated ash, Ash value etc.

### 2. Assay of inorganic medicinals

- |                                     |   |  |
|-------------------------------------|---|--|
| a. Hydrogen peroxide                | - | Redox (Permanganometry)  |
| b. Ammonium Chloride                | - | Acid base (HCHO method)  |
| c. $\text{Ca}(\text{OCl})\text{Cl}$ | - | Redox (iodometry)  |
| d. $\text{CuSO}_4$                  | - | Redox (Iodometry)  |
| e. Boric acid                       | - | Acid base (Glycerine addition)                                   |
| f. $\text{ZnO}$                     | - | Acid base, back titration  |
| g. $\text{NaCl}$                    | - | Argentometry; (ppt 'n)   |
| i. Mohr's method                    |   |  |
| ii. Modified Mohr's method          |   |  |
| iii. Fajan's method                 |   |  |
| h. Calcium Gluconate                | - | (Complexometry)  |
| i. $\text{FeSO}_4$                  | - | Cerric ammonium sulphate titration                               |
| j. $\text{BaSO}_4$                  | - | Gravimetric titration (Using $\text{K}_2\text{Cr}_2\text{O}_7$ ) |
| k. $\text{NaHCO}_3$                 | - | Acid base titration  |

### Special Exercises such as

- Neutralising capacity eg.  $\text{Al}(\text{OH})_3$  gel
- Acidity, alkalinity, bulkiness eg. Barium sulphate
- Water stability, acid stability tests.
- Swelling power, sedimentation volume, coarse particles eg., Bentonite, Kaolin.
- Acid absorption test eg, Magnesium trisilicate.

## REFERENCE BOOKS

- Pharmacopoeia of India
- Practical pharm. Chemistry part I, II - H.H. Beckett and J.B. Stenlake



## 1.8 COMPUTER SCIENCE (With Work Assignment)

### 1. *Introduction to Computers*

Evolution of computer, Generation of computers, functional block diagram of a computer, classification of computers, programming languages, DOS - Operating system, algorithm development, flow charts, decision tables.

### 2. *COBOL*

History of COBOL, structure of COBOL programs, purpose of four divisions, layout of COBOL programs, entries in the Identification and Environment division, COBOL character set. User defined words, COBOL reserve words, literals, entries in the data division, entries in the Procedure division, arithmetic statements (ADD, SUBTRACT, MULTIPLY, DIVIDE), using the three statement components; giving option, rounded option, on size error option, arithmetic operators, COMPUTE statements with ROUNDED and SIZE ERROR options, Move statement. If statement, Accept and Display statements, flow charts for simple problems, sequential input files and output files, OPEN, CLOSE, READ and WRITE statements, table handling, REDEFINES and RENAME clauses, different types of perform statements, Picture editing.

### REFERENCE BOOKS

- |  |  |
|--|--|
| 1. Computer programming in COBOL             | - V. Rajaraman and H.V. Sahasraboudhe,           |
| Prentice Hall of India Pvt. Ltd., New Delhi. |  |
| 2. COBOL for Beginners                       | - Thomas Worth, Prentice Hall of India Pvt. Ltd, |
|  | New Delhi.                                       |
| 3. COBOL for Beginners                       | - Christopher and Seonaid Dazzinger.             |
| 4. COBOL programming                         | - M.K. Roy and D. Ghosh Dastidar                 |

### COMPUTER SCIENCE WORK ASSIGNMENTS (PRACTICALS)

#### COBOL Practicals

1. Write a cobol program for accepting a number and finding whether the given number is odd or even.
2. Write a cobol program to find out the largest number among any three numbers.
3. Write a cobol program for addition of numbers 1 to 100
4. Write a cobol program for adding even numbers between 1 and 100.
5. Write a cobol program to accept a number from the keyboard and to find out whether it is a multiple of 5.

6. Write a cobol program to print multiplication table of a given number from 1 to 10
7. Write a cobol program to print the accept number in the reverse order.
8. Write a cobol program for finding out average of five numbers accepting the values from the key board. Display both accepting values and the results.
9. Write a cobol program for calculation of simple interest accepting the values from the keyboard. Display both the accepting values and the results.
10. Write a cobol program to display perfect cubes between 1 and 100
11. Write a cobol program for adding given digit numbers by using accept and display statement.
12. Write a cobol program calculating and preparing a payslip for an employee accepting values from the keyboard. The details of pay-slip are : EMP. No., NAME, BASIC PAY, DA, HRA, CCA and TOTAL. Calculate DA, HRA, CCA at 20% 10% and 6% of the basic pay respectively.
13. Write a cobol program calculating and preparing a pay-slip for an employee accepting values from the keyboard. The details of the pay-slip are : EMP. NO., NAME, BASIC, PAY, DA, HRA, CCA and TOTAL. Calculate total emoluments of persons getting in the following cases :
  - If Basic pay Rs. 2000, DA = 20% of Basic pay
  - If Basic pay Rs. 2000, DA = 15% of Basic pay
  - If Basic pay Rs. 2000, DA = 10% of Basic Pay
  - If Basic pay Rs. 2000, DA = 6% of Basic pay
  - If Basic pay Rs. 2000, DA = 5% of Basic pay
  - If Basic pay Rs. 2000, DA = 4% of Basic pay
14. Write a cobol program to find out total marks by accepting the values from the keyboard with details : Reg. No., Name, Language 1, Language 2, Physics, Chemistry and Mathematics. Display the results in the marks sheet format.
15. Write a cobol program to prepare a list of pass or fail candidates. Any candidate getting less than 40 marks being treated as failed. The details of the list are : Reg. No., Name, Language 1, Language 2, Physics, Chemistry, Mathematics, Remarks (Pass or Fail)
16. Write a cobol program to check whether scored marks of a candidate in 5 subjects are valid. Assume that the maximum marks in a subject is 100.

**Note :** *Minimum ten practical programs given above should be completed during the course.*

### **General Guidelines for Practicals**

1. The students should enter the computer lab fully prepared for the practicals, i.e., they should have the flow charts and program written on a coding sheet.
2. The lab records should be checked and signed the very next week with date.

### **General Guidelines for Practical assignments**

Problems to be given in the assignment should be based on the practicals listed above or slight modification thereof.



## II YEAR B. PHARM

### 2.1 PHARMACEUTICAL ORGANIC CHEMISTRY II

**Note :** *The subject is to be treated in the light of modern perspective giving stress wherever possible on the following aspects - structure nomenclature, preparation, properties, energy of activation, transition state, resonance stereo-chemistry optical and geometric isomerism etc.*

1. Stereo isomerism and Tetrahedrol - Carbon, optical activity, chirality, chiral centres, Racemic modifications and resolution of racemic mixtures, configuration, specification of R and S configuration, Enantiomerism, Enantiomers, Diastereoisomerism, Meso Structures, Conformational Isomers, reactions of Chiral molecules, Elements of symmetry, Assymetric synthesis E and Z forms.
2. Stereoselective and stereospecific reaction, stereo chemistry of addition of halogens to alkenes, mechanism of stereo chemistry of  $E_1$  and  $E_2$  reactions syn and anti elimination,  $SN^1$  and  $SN^2$  reactions.
3. Geometrical isomerism, its nature and formation, rotation about bond, nomenclature of isomers, determination of configuration, stereo chemistry of cyclic compounds, including biphenyl and stereo chemistry of Nitrogen compounds.
4. Chemistry of biomolecules of pharmaceutical importance Carbohydrates - Introduction, definition, classification, nomenclature, structure determination of glucose, fructose; stereoisomers of monosaccharides, reactions, conversion, configuration of glucose, Cyclic structures of glucose; Determination of ring size, confirmation, Fischer projection formulae and confirmations disachrides and polysaccharides, chemical of maltose, lactose, sucrose, starch, cellulose, used in pharmacy.
5. *Fats and Oils*  
Introduction to chemistry of fats, oils, waxes, occurrence and composition, hydrolysis of fats esterification, fats as source for pure acids and alcohols, Analytical constants of fats and oils, methods for their determination and significances, unsaturaed fats, hardening of oils, hydrogenation of oils, drying, semi-drying and non-drying oils.
6. *Heterocyclic Compounds*  
Classification of heterocyclic compounds, nature and nomenclature, Heterocyclic analogues of cyclopentadeine with one hetero atom. The topic is to be dealt with emphasis on the following - pyrrole, furan, thiophen, introduction, physical and chemical properties, synthetic methods of compounds of Medicinal interest.
7. Fused ring systems involving pyrole, furan and thiophene introduction, physical and chemical properties, structures, synthesis, derivatives and compounds of medicinal interest. Indole, Benzofuran, Thionaphthanones.

8. Heterocyclic analogues of benzene with one hetero atom. Pyridine, introduction, physical and chemical properties, synthesis of derivatives of pyridine.
9. Heterocyclic analogues of naphthalene with one hetero atom. Quinoline, Isoquinoline, Acridine, introduction, physical and chemical properties, structure, synthetic methods, derivatives and compounds of medicinal interest.
10. Compounds with two hetero atoms in five membered ring. Pyrazole, imidazole, isoxazole and oxazole, introduction, physical and chemical properties, structure, synthetic methods. Derivatives and compounds of medicinal importance.
11. Compounds with two or more hetero atoms, pyrimidines, pyrazine, pyridazine, purines, Azepines, Oxepines and dibenz azepines. Introduction, structures and synthetic methods. Chemical reaction and compounds of medicinal interest.

Tricyclics : Phenothiazines, Phenoxazines, Benzodiazepine. Basic structures of compounds used in pharmacy.

12. Preparation, synthesis and reactions of diphenyl - methane, diphenyl ethane, triphenyl methane, naphthalene, phenanthrene and anthracene. Structures, chemical names and medicinal usefulness of derivatives of the above.

### 13. *Amino acids*

Introduction, definition, classification, structure of Amino Acids, essential amino acids their properties, reactions and selected synthesis of amino acids.

Peptide linkage, geometry of peptide linkages, formation determinations of structure of peptides and synthesis, formation of protein, general introduction to protein with examples.

## REFERENCE BOOKS

- |   |                     |
|---|---------------------|
| 1. Organic Chemistry  | - Morison and Boyd. |
| 2. Organic Chemistry Vol I & II                               | - I.L. Finar.       |
| 3. Organic Synthesis - Collective Vol Ib                      | - Culman and Blatt. |
| 4. An Introduction to the Chemistry of Heterocyclic Compounds | - R.M. Axheson      |
| 5. Elementary Practical Organic Chemistry                     | - A.I. Vogel.       |

## PHARMACEUTICAL ORGANIC CHEMISTRY - II (PRACTICALS)

- I Quantitative determination of Organic compounds via functional groups; such as :
  1. - OH Group (Alcoholic and Phenolic)
  2. - COOH
  3. - CHO



4. - C = O
5. Amines and amine HCL
6. - Carbohydrate
7. - Esters Displacement

- II
1. Synthesis of compounds involving more than one step. Atleast six synthesis, should be performed. In addition the following may be attempted.
  2. Fischer's Indole synthesis eg. 1, 2, 3, 4, - Tetrahydro carbozole.
  3. Bechman reaction eg. 4 - methyl 7 hydroxy coumarin.
  4. Diels alder reaction.  
Condensation of anthracene and maleic anhydride or furan.
  5. Synthesis of furan carboxylic acid as furfural.
  6. Synthesis of Antipyrin
  7. Synthesis of Quinaline.

### III *Oil fat analysis*

Acid value, Sap Value,, Iodine Values detection of adulterants in oils.

## REFERENCE BOOKS

1. An Introduction to Chemistry of Heterocyclic Compounds - R.M. Acheron.
2. Elementary Practical Organic Chemistry - A.I. Vogel.
3. Organic Chemistry Vol. I & II - I.L. Finar
4. Organic Synthesis, Collective Vol. 3 - Gilman and Blat
5. Stereochemistry of Carbom Compounds - Eliel E.L.
6. Elem. Practical Organic Chemistry Vol I, II & III - A.I. Vogel.
7. Practical Organic Chemistry - Mann and Saunders.

## 2.2 APPLIED BIO-CHEMISTRY

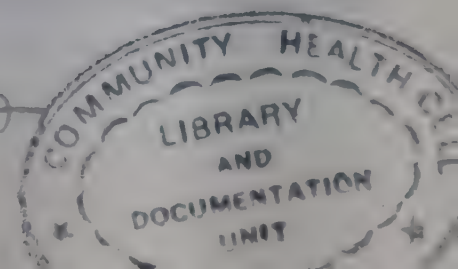
*Objectives, scope and application of Biochemical Principles to Pharmacy*

### 1. *Enzymes*

Nomenclature, classification IUB, Kinetics, Mechanism of action, induction and inhibition, isolation and purification of enzyme.

Coenzymes in Metabolism

### 2. Biochemical role of hormones and vitamins



3. *Bioenergetics*  
The concept of free energy, determination of  $\Delta G$  from equilibrium constant and reductive potential, energy rich compounds, production of ATP and its biological significance, cyclic AMP and its biological significance.
4. *Carbohydrate Metabolism*  
Glycolysis, Glycogenesis, Gluconeogenesis, Embden - Mayerhof Pathway, TCA cycle, HMP Pathway, Uronic acid pathway, interconversion of Sugars.
5. *Lipid Metabolism*  
The fate of dietary lipids, oxidation of saturated and unsaturated fatty acids Metabolism of Ketone bodies, Biosynthesis of saturate and unsaturated fatty acids, cholesterol metabolism.
6. Electron transport and biological oxidations
7. *Protein metabolism*  
Dynamic state of protein, Nitrogen balance, Amino Acid metabolism, transamination, decarboxylation, deaminations, formation of urea, creatine, creatinine and their significance, Intermediate metabolism.
8. *Nucleic Acid*  
Metabolism and Basic properties (Property) of DNA & RNA, genetic code, protein synthesis, Mutation repair mechanism.
9. Principles and significance of following Biochemical tests - Kidney function tests, Liver function tests. Lipid profile, Biochemicals tests in Endocrine diseases.

### **APPLIED BIO-CHEMISTRY (PRACTICALS)**

1. Qualitative determination of normal constituents of urine.
2. Qualitative determination of abnormal constituents of urine.
3. Quantitative estimation of casein in milk.
4. Quantitative estimation of Reducing sugar in urine.
5. Quantitative estimation of glucose in blood.
6. Quantitative estimation of cholesterol in urine.
7. Quantitative estimation of calcium in urine.
8. Quantitative estimation of creatinine in urine.
9. Quantitative estimation of sodium and potassium in urine.
10. Quantitative estimation of chloride.
11. Quantitative estimation of creatinine in urine.
12. Quantitative estimation of protein.



13. Determination of salivary amylase activity.
14. To study influence of temperature of salivary Amylase activity.
15. To study influence of pH on salivary Amylase activity.
16. Determination of SGOT & S.G.P.T.
17. Determination of lactose in Milk.
18. Determination of Free and total gastric acidity.
19. To perform urea clearance, Renal acidifying ability, urea clearance/creatinine clearance.
20. To perform liver function tests.  
(Bilirubin metabolism, differential diagnosis in jaundice, carbohydrates, Metabolic test (galactose, glucose, fructose) determination of plasma, proteins, flocculation test (Hippuric acid synthesis test).

### REFERENCE BOOKS

- |                                       |                               |
|---------------------------------------|-------------------------------|
| 1. Handbook of Basic Pharmacokinetics | - <i>Pitachel.</i>            |
| 2. Harper Review of Bio-chemistry     | - <i>Martin</i>               |
| 3. Outlines of Bio-chemistry          | - <i>Conn &amp; Stump.</i>    |
| 4. Bio-chemistry                      | - <i>Lehninger.</i>           |
| 5. Text Book of Bio-chemistry         | - <i>Harron &amp; Mazur.</i>  |
| 6. Hawk's Physiological Chemistry     | - <i>Oser.</i>                |
| 7. Text book of Bio-chemistry         | - <i>Rama Rao.</i>            |
| 8. Text book of Bio-chemistry         | - <i>Varunkumar Malhotra.</i> |

## 2.3 PHARAMACEUTICAL ANALYSIS

This courses shall cover the theoretical basis of analysis, methods of assay mentioned in Indian Pharmacopoeia can be taken as example.

1. Computation of analytical results, significant figures; concept of errors, precision and accuracy, standard deviation, Rejection of doubtful values with special reference to volumetric and gasometric analysis; calibration of analytical equipments and its handling; sources of error, type or errors, methods of avoiding or minimising errors, computation of anticipated errors.
2. Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards, absolute standards, derived standards of volumetric solutions, preparation, standarisation and storage of volumetric solutions.
3. Principles of neutralization reactions and various acid based titrations involving direct titration, back titration, alkaline hyhdrolysis and displacement titrations.

- 3a. Theory of indicators, types of indicators, neutralisation, Redox, precipitation, absorption and self indicators for detecting end point in titrations.
4. Principles of oxidation reduction titrations, oxidation potential, Nernst equation, classification of redox Titrations, Permangnometry, dichromatometry cerimetry Iodimetry, Iodometry, Bromometry and their use in pharmaceutical analysis.
- 4a. Precipitation titrations, - Mohr's, Volhards', modified Fajan's, Leibieg's, modified Liebieg's methods, precipitation indicators and Adsorption indicators used in pharmaceutical analysis.
5. Principles of gravimetric analysis : Typical methods involving precipitation, coagulation, incineration and digestion procedures. Eg. estimation of chloride  $\text{SO}_4$ , Ag, Ba, Mg, Aluminium, Aluminium hydroxide gel, Zinc sulphate and Zinc oxide.
- 5a. Organic precipitants and their advantages and applications with examples.
6. General principles of gas analysis (Instrumentation should be included for official gases, absorbents used for  $\text{O}_2$ , CO,  $\text{CO}_2$ ,  $\text{N}_2\text{O}$ ,  $\text{H}_2$ , He) common apparatus for gas Analysis, Nitrometer, Hempel pipettes, burette, Frankeburette, orsats-apparatus.
7. Ionic equations and solutions of stoichiometric and analytical problems; concening analytical methods.
8. Theory of semi micro inorganic qualitative analysis, Interfering radicals, reactions, identification and elimination.
9. Non-aqueous titrations - theory of non aqueous titration, classification of solvents used in non-aqueous titration, applications for different types of non-aqueous titration, Sodium benzoate, Ephedrine HCl.  
The examples should be given from I.P. or B.P.
10. Complexometric titration: Introduction, Definition of the different terms involved, types of titrations method of detecting end points.

## **PHARMACEUTICAL ANALYSIS I (PRACTICALS)**

1. Introduction to the use and care of apparatus and equipment for simple chemical analysis.
2. Selected experiments on acidimetry, alkalimetry.
3. Selected experiments on oxidation reduction reactions.
4. Selected experiments on precipitation reactions.
5. Selected experiments on gravimetric analysis et. Caffeine, Citrate, sodium Lauryl sulphate etc.



## Recommended Exercises

### I Qualitative Analysis

1. Tests for identification and confirmation of I group acid radicals Carbonate, bicarbonate, Nitrates, Sulphites, Sulphides, Acetates, Thiosulphates.
2. Test for identification and confirmation of II group acid radicals  $\text{NO}_3$  Halides, Acetate, Tartarate, Citrate, Oxalate.
3. Test for identification and confirmation of III group of acid radicals. Borate, Phosphate, Arsenite, Arsenate, Sulphate.
4. Systematic qualitative separation and test for confirmation for I-VI group basis radicals.
5. Study of effect of interfering radicals-Acetate, Citrate, Tartarate, Oxalate.
6. Study of Elimination of interfering radicals:
  - a) Organic interfering radicals - Acetate, Oxalate, Citrate, tartrates
  - b) Inorganic interfering radicals - Phosphate, Borate.
7. Unknown sample:
  - a) 4 radicals with interfering radicals
  - b) 4 radicals without interfering radicals - 6 Nos.

(Note: Semi micro techniques to be followed.)

### II Quantitative Analysis

- a) Exercises, involving the following assays for class work; weighing of samples should be included. Assays of:
  1. Citric acid
  2. Benzoic acid
  3. Acetyl Salicylic acid
  4.  $\text{FeSO}_4$
  5.  $\text{FeSO}_4 \times \text{K}_2\text{Cr}_2\text{O}_7$  (using external and internal indicators).
  6.  $\text{FeSO}_4 \times \text{Ceric Ammonium sulphate}$
  7. Sodium salicylate (Bromide-Bromate method)
  8. Phenol
  9. Mohr's method (Sodium chloride)
  10. Volhard's (Ammonium chloride)
  11. Modified Mohr's method (Ammonium chloride)
  12. Fajans method (Sodium Chloride)
  13. Complexometric titration of cal-chloride/gluconate or mag.sulphate.
  14. Non-aqueous titration
    - a) Non-aqueous titration of an acidic substance
    - b) Non aqueous titration of basic substance-sod. benzoate, Ephedrine HCl, as examples.

- b) Gravimetric analysis - simple gravimetric exercises
  - a. To estimate  $\text{BaSO}_4$  as Barium sulphate
  - b. Alum as  $\text{Al}(\text{OH})_3$
  - c. Caffeine citrate as anhydrous caffeine
  - d. Sodium lauryl sulphate as lauryl alcohol etc.

## REFERENCE BOOKS (THEORY AND PRACTICAL)

1. Text book of Quantitative Inorganic Analysis - including Instrumental Analysis - *A.I. Vogel.*
2. Bentley Drivers text book of Pharmaceutical Chemistry.
3. Pharmacopoeia of India.
4. Practical Pharmaceutical Chemistry part I & II - *Backett A.H. and Stenlake J.B.*
5. Quantitative Analysis - *Ayers*
6. Quantitative semi-micro and Microinorganic Analysis - *A.I. Vogel.*
7. Semimicro Qualitative Analysis - *Hilrsush.*
8. Semimicro Qualitative Analysis - *F.J. Welcher & R.B. Hatin*
9. Principles and methods of Chemical Analysis - *Walton.*
10. Pharmaceutical Chemistry Vol. I - *Chatten.*

## 2.4 PHARMACEUTICAL MICROBIOLOGY

1. Introduction to the science of microbiology. Various ancient theories concerning microbial world and contribution of different scientists the development of microbiology. Major divisions of the Microbial world and relationship among them.
2. Classification of microbes and detailed study of Bacteria, Fungi, Actinomycetes, Rickettsiae, Spirochaetes and Viruses.
3. Nutrition, growth and cultivation of Bacteria and Virus. The construction of culture media. Organic growth factors. Study of important media including media for aerobic and anaerobic organisms differential media, enriched media and other specific media, maintenance of laboratory culture.
4. Different method used in isolation and identification of different bacteria. Study of important biochemical reactions and motility testing. Staining methods including principles involved in simple, differential, negative, spore, capsule and flagella staining. Pure culture techniques and bacterial counting.
5. Detailed study of different method of sterilisation including merits and demerits. Equipments and evaluation of sterilisation methods. Sterilisation of important



pharmaceutical dosage forms listed in I.P. Sterility testing including principles and methods of sterility testing of soluble, insoluble and oily samples, surgical dressings and sutures, ligatures, Ophthalmic preparations, preparations containing antimicrobial materials and other important groups of samples.

6. *Disinfection*

Study of disinfectants, antiseptics, fungicidal and virucidal agents. Factors affecting their activity, mechanism of action, application and toxicity. Microbial tests and evaluation of bactericidal bacteriostatic and virucidal activity, Evaluation of preservatives in pharmaceutical preparations.

7. *Microbial genetics*

Introduction, phenotypic and genotypic changes. Study of bacterial transformation, transduction and conjugation, Principles and methods involved in development of strains. Plasmids and Transposons.

8. Microbial flora of Human, Pathogenicity, process after infection, Penetration, Microbial Virulence factors, defence mechanisms and basic aspects of Immune response. Study of different modes of transmission, Prevention and diagnosis of infections caused by Salmonella, Shigella, Vibrio, Clostridium, Corynebacterium, Mycobacterium, Viruses like HIV, Polio, Measles, Influenza and other infectious diseases.

9. *General principles of Immunology*

The structure and formation of Antigen and Antibody, Antigen-Antibody reactions. Serological and diagnostic tests such as Schicks test, Widal test, Wassermann tests, Tuberculin test, Elisa test, Western blotting and other important tests. Study of Auto immune disease and immune deficiency disorders.

10. Principles and methods of different microbiological assays including sensitivity tests. Microbiological standardisation of Ampicillin, Streptomycin, Vit B12. Standardisation of Vaccines and sera.

## REFERENCE BOOKS

- |   |                   |
|---|-------------------|
| 1. Fundamentals of Microbiology         | - Frobisher       |
| 2. General Microbiology                 | - Stainer         |
| 3. Microbiology                         | - Pelczar         |
| 4. Bentley's Text book of Pharmaceutics | - Rawlins         |
| 5. Pharmaceutical Microbiology          | - Huge and Russel |
| 6. USP, IP, BP.                         |                   |
| 7. Microbial Genetics                   | - Friedlandur     |
| 8. Clinical Immunology                  | - Ivan M. Riotts  |
| 9. Essentials of Immunology             | - Coleman         |

## PHARMACEUTICAL MICROBIOLOGY (PRACTICALS)

1. Study of apparatus used in experimental microbiology.
2. Sterilisation of glasswares, surgical cotton, dressing and other appliances.
3. Preparation of Sterilisation of different media.
4. Staining: Simple, Gram's staining, Acid fast staining Negative staining, Metochromatic staining.
5. Motility testing.
6. Total count and viable count.
7. Study of colony characters.
8. Isolation of pure culture.
9. Biolchemical tests.
10. Sensitivity testing of Powders, Liquids, Oily turbidimetric methods.
12. Sterility testing of Powders, Liquids; Oily preparations, Cotton dressings, etc.,
13. Determination of minimum inhibitory concentration (MIC) and phenol coefficients.
14. Study of Yeast, Aspergillus Penicillium

## 2.5 PHYSICAL PHARMACY I I

### 1. *Colloids*

Size and shape of colloidal particles. Study of the various colloidal systems. Preparation purification and evaluation of colloids. Sensitization and protective colloidal action. Properties of colloids; optical, kinetic; Electrical and Electrokinetic property. Micellar solubilization. Pharmaceutical application of colloids. Simple problems on colloidal preparations.

### 2. *Coarse dispersions*

- i) Suspensions- Interfacial properties of suspended particles. Settling in suspensions Flocculated and deflocculated suspensions. Controlled flocculation. Flocculation in presence of structured vehicles, preparative techniques, formulation of suspensions and evaluation of suspension stability.
- ii) Emulsions - Types, classification of emulsifying agents based upon their mechanism of action. Formulation of emulsions. Physical stability of emulsions - Evaluation of emulsion stability. Theories of emulsification. Multiple emulsions, micro emulsions.

### 3. *Rheology*

Newtonian and Non-Newtonian systems. Study of Rheograms. Flow equations for pseudoplastic and Dilatant materials. Thixotropy and its applications in pharmacy. Measurement of the extent of Thixotropic breakdown. Study of instruments like



Ostwald's viscometer, falling sphere viscometer, cup and bob, cone and plate viscometers, Brooke's viscometer. Viscoelasticity. Applications of Rheology to Pharmacy (simple problems).

4. *Chemical Kinetics*

Rate, order and molecularity of a reaction. Zero-order, Pseudozero order, First-order, Pseudo-first order and second order reactions. Units associated with specific reaction, rate constants. Half-life and the order of a reaction; determination of order of a reaction. Application of reaction kinetics to the stability testing of pharmaceuticals viz 1) construction of Arrhenius plot 2) Determination of shelf-life 3) Calculation of overages (simple problems). Stabilisation of drugs against 1) light, 2) Hydrolysis and 3) Oxidation.

5. *Diffusion and Dissolution*

Steady state diffusion. Apparatus used to measure Diffusion. Diffusion principles in biological systems. Noyes Whitney equation. The Hixoncrowell cube root law. Diffusion controlled drug release systems.

6. *Complexation and protein binding*

Types of complexes, complexation and drug action. Methods of analysis of complexes. Proteinbinding, Methods available for determination of protein-binding.

7. *Micromeritics*

Particle size and size distribution. Number and weight distributions. Hatch-Choate equations. Porosity and packaging arrangements. Particle density. Bulkiness. Flow properties of powders. Methods available for measurement of particle size (Simple problems).

8. *Polymers*

Definition, Molecular weight average, Preparation of polymer solutions. Molecular weight determination from solution viscosities. Polymers as thickening agents. Gelformation, Co-acervation Pharmaceutical applications of polymers.

9. *Interfacial phenomenon*

Surface and interfacial tensions. Measurement of interfacial tension. Formation of electrical double layer. Freundlich and Langmuir's Adsorption isotherms, concept of H.L.B. No., Angle of contact, its significance, significance of spreading co-efficient, B.E.T. Adsorption isotherm.

## **PRACTICALS - LIST OF EXPERIMENTS**

1. Determination of sedimentation volumes for suspensions stabilised with various thickening agents like Acacia, Tragacanth, P.E.G. Sodium alginate, methyl cellulose,



Ethyl cellulose. Study of their relative stabilizing capacity in respect to cake compactness, ease of redispersibility etc.

2. Suspension formulation by controlled flocculation using electrolytes and determination of sedimentation volume and degree of flocculation in case of sulphate suspension and bismuth carbonate suspensions.
3. Study of Rheological behaviour and construction of Rheograms for petroleum, Jelly, Bentonite magma and magnesia magma using a multipoint viscometer.
4. Determination of viscosity of castor oil using falling sphere viscometer.
5. Determination of optimum H.L.B. value for liquid paraffin to be presented in the form of O/W emulsion and formulation of liquid paraffin emulsion and its evaluation.
6. Determination of H.L.B. values of surfactants and surfactant blends (two each).
7. Preparation, purification and evaluation of Arsenic Sulphide and Ferric hydroxide - colloid.
8. Study of Donnan membrane effect on enhancing the absorption of drugs across the biological membrane.
9. Determination of critical micelle concentration of an Association colloid by measurement of surface tension.
10. Determination of critical micelle concentration by measurement of electrical conductance in case of Ionic surfactants.
11. Determination of C.M.C by measurement of viscosity and intrinsic viscosity.
12. Study of particle size distribution in case of Boric acid crystals using optical microscopy; construction of Histogram.
13. Determination of bulk density, rate of flow and Angle of repose for powders and granules.
14. Determination of rate constant for hydrolysis of Methyl Acetate in Acidic medium (first order).
15. Determination of rate constant for hydrolysis of Ethylacetate in alkaline medium when initial reactant molar concentrations are the same (second order).
16. Determination of rate constant for hydrolysis of Ethyl acetate in alkaline medium when the initial molar concentrations of the reactants are different (Second order).
17. Study of effect of temperatures on reaction rates and construction of Arrhenius plot.
18. Determination of  $t_{1/2}$  for degradation of drugs.
19. To carryout the dissolution profiles for Nitro-Furantoin tablets and sulphanilamide tablets.
20. Study of protein binding of drugs on serum Albumin.
21. Determination of Molecular weight for a polymer by measure of Intrinsic viscosity.
22. Study of Adsorption pattern of solutes on Activated Carbon. Construction of Freundlich and Langmuirs isotherms.



## REFERENCE BOOKS

- |   |  |
|---|--|
| 1. Physical Pharmacy  | - A.N. Martin  |
| 2. Remingtons Pharmaceutical Sciences   | - Latest Edition                                       |
| 3. Pharmaceutics and Pharmacy practice  | - G.S. Banker and R.R. Chalmers.                       |
| 4. Bentley's text book of Pharmaceutics   | - E.A. Rawlins.  |
| 5. Tutorial Pharmacy  | - Cooper and Gunn.                                     |
| 6. Theory and practice of industrial pharmacy   | - Leon Lachman, Herbert A Lieberman and Joseph L Kanig |
| 7. Experimental pharmaceutical technology   | - Eugene L.Parrot and Saski                            |
| 7a. Also Fundamental Pharmaceutics  | - Eugene L.Parrot and Saski                            |
| 8. Chemical stability of pharmaceuticals  | - R.A. Connors   |
| 9. Chemical rate processes in pharmaceutical technology - series on Advances in Pharmaceutical Sciences | - Yang W.  |
| 10. Physical Pharmaceutics  | - Schotten and Ridgway                                 |
| 11. Pharmaceutics of solids and solid dosage forms  | - J.T. Cartensen                                       |
| 12. Advance in Pharmaceutical Sciences  | - Bean and Beckett                                     |
| 13. Kirck Othmer Encyclopedia of Chemical technology Vol 1 to 22  |  |
| 14. Theory of pharmaceutical system Vol. 1 and 2 General principles                                     | - T.J. Cartensen                                       |
| 15. Chemical Kinetics   | - J.N. Gurtu and Kapoor.                               |

## 2.6 PHARMACOLOGY I

### 1. *General Principes of Pharmacology*

Introduction, Nature and source of drugs, Routes of administration of drugs, Absorption and Bio-vaailability and factor affecting them. Drug distribution, Bio-transormation and excretion.

Mechanism of drugs action including Drug-Receptor interactions and the factors influencing.

**Note :** *The term pharmacology used here refers to the classification, mechanism of action, pharmacokinetics, pharmacodynamics, adverse effects, toxic effects, contraindications, therapeutic uses, preparations and dosages.*

### 2. *Autocoids and drug therapy of inflamation*

i) Pharmacology of histamine and antihistamines

ii) Pharmacology of serotonin and its antagonists

iii) Study of lipid derived autocoids and platelet activating factor.

3. *Pharmacology of drugs acting on CNS*
  1. General considerations
  2. General anaesthetics
  3. Local anaesthetics
  4. Hypnotics and Sedatives
  5. Antipsychotic drugs
  6. Anticonvulsants
  7. CNS stimulants
  8. Treatment of parkinson's disease, spasticity and acute muscle spasms.
4. Pharmacology of Analgesics, Antipyretics, Antinflammatory, Antigout, Antiarthritic and Antitussives.
5. Drug addiction and drug abuse, tolerance and physical dependence, withdrawal symptoms and drug addiction.
6. *Pharmacology of drugs acting on CNS*
  1. General considerations
  2. Cholenomimetics drugs
  3. Anticholinergic drugs, (antimuscarinic, skeletal muscle relaxants, ganglion blockers)
  4. Sympathomimetic drugs
  5. Sympatholytics.
7. Pharmacology of diuretics and antidiuretics
8. Pharmacology of drugs acting on CVS
  1. Cardiotonics
  2. Antiarrhythmics
  3. Antianginal
  4. Antihypertensives
  5. Treatment of hyperlipoproteinemia

## REFERENCE BOOKS

- |  |   |
|--|---|
| 1. Goodman and Gilman's "The Pharmacological Basis of Therapeutics" latest edition | - Alfred Goodman Gillman, Theodore W Rall Pergamon Press. |
| 2. Lewis's Pharmacology, latest edition  | - James Crossland, Churchill Livingstone.                 |
| 3. Drill's Pharmacology in Medicine  | - Joseph R B Dipalmo, MC Graw Hill Book Company.          |
| 4. Pharmacology and Pharmacotherapeutics   | - R.S. Satoskar and S.D. Bhandarkar, Popular Prakasan.    |



- |   |  |
|---|--|
| 5. Essentials of Pharmacology                     | - <i>K.D. Tripathi.</i>  |
| 6. Rang and Dale's T.B. of Pharmacology           |  |
| 7. Pharmacological Principles of Medical Practice | - <i>Krantz and Carr,</i><br>The Williams and Wilkins Company. |
| 8. Indian Pharmacopoeia.                          |  |
| 9. Clinical Pharmacology                          | - <i>Lawrence and Bennet, ELBS.</i>                            |

### PHARMACOLOGY I (PRACTICALS)

1. Study of appliances used in experimental pharmacology
2. Study of physiological salt solutions
3. Maintenance and breeding of laboratory animals
4. Routes of administrations
5. To study the synergistic effect of drugs using rectus preparations
6. To study antagonistic effect of drugs on rectus preparations
7. To study the action of agonists using isolated frog heart preparation
8. To study the asction of antagonistic effect of drugs using rectus preparation
9. To study the cardiotonic action of drugs on isolated frog preparation
10. To study the effect of drugs using frog blood vessel preparations
11. To study the effect of histamine and antihistamine using Guinea pig ileum preparation
12. To study the effect of 5 HT and its antagonist using Rat fundus preparation
13. To study the anticonvulsant property of drugs by using chemicals to induce convulsions
14. To study the anticonvulsant property of drugs by inducing seizures by electric shock (using convasio meter)
15. To study the analgesic property of drugs by thermal method (Eddy's hot plate)
16. To study the analgesic property of the drugs using chemical agents.
17. To study the toxicity induced by metals
18. To study the pesticides toxicity in animals

### REFERENCE BOOKS (PRACTICALS)

- |   |  |
|---|--|
| 1. Text book of 'In Vitro' Practical Pharmacology       | - <i>Ian Kitchen, Blackwell Scientific Publications, Oxford, Roudon....</i>                      |
| 2. Pharmacological experiments on Isolated preparations | - <i>Staff of Dept. of Pharmacology, University of Edinburgh (Perry's), E&amp;S Livingstone.</i> |
| 3. Pharmacological experiments on intact preparations   | - <i>Staff of Dept. of Pharmacology, University of Edinburgh, (Perry's).</i>                     |

- |    |  |   |  |
|----|--|---|--|
| 4. | Fundamentals of Experimental Pharmacology            | - | <i>M.N. Ghosh,</i><br>Scientific Book Agency, Calcutta.          |
| 5. | Handbook of Experimental Pharmacology                | - | <i>S.K. Kulkarni,</i><br>Vallabh Prakashan, Delhi                |
| 6. | Experimental Pharmacodynamics                        | - | <i>T. Koppanyi &amp; A.G. Kazezmar,</i><br>Burgen Publishing Co. |
| 7. | Screening methods in Pharmacology                    | - | <i>Robert A Turner,</i> Academic Press.                          |
| 8. | Evaluation of Drug Activities and<br>Pharmacometrics | - | <i>D.R. Lawrence, A.C. Bacharach.</i>                            |

## 2.7 PATHOPHYSIOLOGY AND TOXICOLOGY

### Section A (PATHOPHYSIOLOGY)

1. Introduction.
2. Abnormalities in hyper lipoproteinaemia, Glycogen infiltration and glycogen storage diseases.
3. Pathology classification, uratic infiltration.
4. Pathogenesis of acute inflammation, chemical mediators of inflammations, types, chronic inflammations, repairs of wounds in the skin, factors influencing healing of wounds.
5. Physiological and pathological autotoxins. Hypersensitivity type I, II, III, IV; Allergy due to food, chemicals, allergens, drugs, biological significance of hypersensitivity.
6. Auto immunity, criteria for auto immunity, classification of Auto immune diseases in man, mechanism of auto immunity, Aids.
7. Transplantation and immunological tolerance, allograft reaction, transplantation antigens, mechanism of rejection of allograft.
8. Types of shock, mechanisms and principles.
9. Biological effects of radiations.
10. Disturbances of nutrition, circulatory disturbances, haemorrhage.
11. Disturbances of growth of cells, general biology of tumours, spread of malignant tumours, etiology and pathogenesis of cancer.



## Section B (TOXICOLOGY)

1. Acute, sub acute, chronic toxicity. Therapeutic index, teratogenecity, carcinogenecity.
2. Genetic factos influencing toxicity.
3. General principles of treatment of acute toxicity & active poisoning
4. Precaution of poisoning, poison control.
5. Poisoning due to
  - (i) Drugs/drug - Hypnotics and sedatives, tranquillisers, Anticonvulsants, Antidepressants, Salicylates, Opiates, Cardiovascular drugs, Bronchodilator drugs, Catecholamines and noncatecholamines, Alcohol, Methanol, Ethylene glycol, Aliphatic, Aromatic and Chlorinated compounds.
  - (ii) Household products - Cleaning products, surfactants, disinfectants & antiseptics, solutions, cosmetics.
  - (iii) Marine animals.
  - (iv) Plants and fungi like mushrooms, atropine, datura, aconitum.
  - (v) Snake bite.
  - (vi) Heavy metals, acute & chronic effects (with special reference to Iron, Lead, Mercury Arsenic).

## REFERENCE BOOKS

- |   |   |
|---|---|
| 1. General Pathology                              | - Y.M. Bhende, S.G. Deodhare, S.S. Kelkar, (Popular Prakashana) |
| 2. Screening methods in Pharmacology              | - Robert A Turner, (Academic press)                             |
| 3. Animal experiments in pharmacological analysis | - Floyd R Domer. (Charles & Thomas)                             |
| 4. Poisoning Diagnosis and Treatment              | - Ed J.A. Vale and T.J. Meredith (Update Books).                |

# III YEAR B. PHARM

## 3.1 MEDICINAL CHEMISTRY - I

1. Introduction to Medicinal Chemistry, History and development of medicinal chemistry, concepts of drugs, definition and fundamental principles of drug therapy.
2. Physico-chemical properties of drug molecules in relation to biological activity such as solubility, particle size, surface area, chemical bond, partition coefficient, protein binding, complexation, Metal ion complexation, Ionisation, PKa value, Iso-sterism, Isomerism, Geometrical and optical isomers, Steric effect, Redox potential, Bio availability etc.
- 3a. General principles of drug action, Fate of drug, Drug metabolism, factors affecting drug absorption, metabolism and elimination, drug receptor interaction.
- 3b. Drug design: concepts, principles and modern scientific methods of drug design
4. Introduction, definition, chemical classification (other types of classification wherever relevant) with eg, chemical name, structures, mode of action of representative types, synthesis, SAR and general metabolism as mentioned below, and uses of the following classes of drugs.

### I Anti Infective Drugs

General concepts of the following infective diseases and commonly used drugs should be discussed.

- i. Anti Amoebics: Chinioform, Iodochloroquine, diiodo hydroquinol, diloxanide, carbarsone, metronidazole Tinidazole, Tetracycline, erythromycin, emetine.
- ii. Trypanosomicides: Pentamidine, Suramine, trypasancide.
- iii. Antahelminthics: Piperazinecitrate, mebendazole, diethylcarbamazine, Thiabendazole, Hexyl resorcinol, Niclosamide, Befinium hydroxy naphthoate, stibophen.
- iv. Anti Viral: Idoxuridine, Amantadine, interferon.
- v. Antifungal: Fucytosine, Amphotericin-B, Sulphadiazine, Griseofulvin, Co-trimazole, Tolnaftate, Nystatin.
- vi. Antibacterial: Sulphonamides: sulphanilamide, NI, N4 substituted derivatives, sulphadiazine, sulphamerazine, sulphadimidine, sulphamethoxazole, sulphamethoxy pyridazine, sulphacetamide, succinyl sulphathiazole, phthalyl sulphathiazole and trimethoprim.



## II. Chemotherapeutic Agents

- i. Antimalarials: Quinine, Chloroquine, primaquine, pampaqueine, Azacrine, chlorproguanil, pyrimethamine.
- ii. Antitubercular agents; INH, PAS, ethambutol, cycloserine, pyrazinamide, ethonamide.
- iii. Antileprotic agents: Dapsone, DAADS, sulfoxonesodium, glucose-sulphone sodium, rifampicin, streptomycin, clofazamine.

## III. Antibiotics

In general, classifications, natural penicillins, Degradation products, semisynthetic penicillin, enicilline-V, Ampicillin, amoxycillin, Carbenicillin, cephalexin, cephaloredin, cephalothin, chloramphenical streptomycin, Neomycin, Kanamycin, Gentamycin, Novabiocin, Bacitracin, Polymixin, Nystatin, Tetracyclines, Erythromycin, olendomycin, grieseofulvin, Fusidic acid, paramomycin.

## IV CVS Acting Drugs

- i. Antihypertensive drugs: Propranolol, oxprenolol, Guanethedine, Hydralazine, Methyldopa, Reserpine.
- ii. Vasodilators: Nitrites and Nitrates, Amylnitrite, Nitro-glycerine, Isosorbidedinitrite, dipyridamole.
- iii. Antiarrhythmic agents: Quindine, procainamide, verapamil Nefedepine.
- iv. Anticholoesteramic agents: Nicotinyl alcohol, laevthyroxine sodium, lio-thyronine sodium, cholestryamine, clofibrate.
- v. Coagulants: menodione, Acetomenadione.
- vi. Anticoagulants: Herapin, Nicotinyl alcohol, pheninidione, ethylbis coumaracetate, dicoumarol, urokinase, streptokinase, warfarine.
- vii. Hypoglycemic agents: Tolbutamide, carbutamide, chlorpropamide, glibenclamide, phenformine, metformin.
- viii. Thyroid agents: D-Thyroxine, L Thyroxine sodium.
- ix. Antithyroid agents: Propylthiouracil, methylthiouracil, carbimazole.

## V. Diuretics

Mersalyl, Acetazolamide, Frusemide, Ethacrynic acid, Chlorthiazide, Hydrochlorthiazide, Spiranolactone, Aldosterone.

## VI. Anti Histaminics

Diphenhydramine, doxylamine, mepyramine, chlorpheniramine, pyricamine, Tripelennamine, Phenindamine, trimeparazine, promethazine, chlorpromazine, cimetidine, Ranitidine, Famotidine.

## VII. CNS Deprssents

- i. Sedative hypnotics: Phenobarbitone, pentobarbitone, pentothal sodium, Allobarbitone, quinobarbitol, hexobarbitol, carbromol, Bromural, sedormid.
- ii. Anticonvulsants: Phenytoin, mephentoin, Ethotoin, promidoin, methbarbitol, carbamazepine, ethosuccimide, trimethadione, clonazepams, lorazepam, valporic acid.

## VIII. Psychotropic Agents

- i. Tranquillizers: Chlordiazepoxide, Diazepam, clonazepam, meprabamate, Hydroxyzine, promethazine, propanalol, Trifluoperzine, Amytryptaline, Haloperidol, Chlorprothixine, Nitrozepam.
- ii. Muscle relaxants: Mephenesine, Meprobamate, Tybamate, Cyclobamate, Diazepam, Chloridiazepoxide.

## IX. Analgesics, Antipyretics, Anti inflammatory

- i. Narcotic Analgesics: Morphine, Pethidine, Methadone, Alpha Prodine, Metapone, Pentazocine, Phenazocine, Cyclazocine.
- ii. Narcotic antagonists: Naloxone, Nalorphine, Levellorphan.
- iii. Peripheral analgesics: Antiphyretics, Anti inflammatory agents - Aspirin, mefenamic acid, indomethacin, diclofenac sodium, Ibuprofen, ketoprofen, Naproxen, phenyl butazone, oxyphenbutazone, paracetamol, Analgin, Antipyrin, Allopurinol, Cortisone, Prendnisolone, prednisone, cortisol.

## X. Antineoplastic Agents

Procarbazine, 6 Mercapto Purine, 5-fluorouracil, chlorambucil, Thiotepa, cyclophosphanamide, Melphalon, Actinomycin-D, Mitomycin Bleomycin, vincristine, vinblastine, Mustine, allopurinol, Methotrexate.

## XI. Local Anaesthetics

Cocaine, Procaine, Benzocaine, Lidocaine, Dibucaine, Tertracaine.

## XII. Locally Acting Antiinfectives

- i. Antiseptic, Disinfectants: Mercurochrome, Acriflavine, proflavine, Halazone, Cetrimide



- ii. Urinary tract antiseptics: Nitrofurantoin, Nitrofurazone, Furazolidone, Nalidixic acid, Hexamine, Mandelic acid.

### **XIII. Anti Aids Drugs**

General discussion of AIDS diseases, AZT, Suramin, Immunoglobulin, etc.

### **XIV. Diagnostic Agents and Radiopharmaceuticals**

- i. Diagnostic agents: Iodoxy, Iopanoic acid, Iothalamic acid, Iodohippurate, Diatrizoic acid, sulphobromophthalein, phenol sulphothalein, Evans blue, Diagnox blue, phenindiol.
- ii. Radio pharmaceuticals: Radio sodiumiodine, Radio sodium phosphate, Chlormerodrin, Aggregated serum albumin iodine 131. General introduction of standards, radioactive hazards and prevention in handling Radio pharmaceutical may be discussed.

### **XV. Pharmaceutical Aids**

Name, structure, special characters of:

- i. Preservatives and antioxidants
- ii. Colouring/flavouring/sweetening agents
- iii. Suspension agents, stabilizers and emulsifiers.

#### **NOTE:**

- i. SAR of following classes of drugs should be discussed.
  - 1. Sulphonamides, 2. Anti malarials, 3. antibiotics, (Chloramphenicol, tetracyclines), 4. Psychotropic drugs (Phenothiazine, phenorazine, Butyrophenones, Benzodiazepines), 5. Local Anaesthetics, 6. Narcotic analgesics and antiinflammatory drugs, 7. Benzothiazides.
- ii. General metabolism of following classes of drugs should be discussed in brief:
  - 1. Sulfonamides 2. Barbiturates.
- iii. Maximum possible synthesis should be discussed from compounds underlined, under each class of drugs listed above, included in latest I.P. and other popular drugs used in practice.

## **MEDICINAL CHEMISTRY I (PRACTICALS)**

- 1. The practical Scheme comprises of the following types of experiments taking from I.P. (1985 ed).

- a) Monograph Analysis of selected I.P. official compounds including
  - i. Identification tests: Solubility, acidity/alkalinity tests. test for purity, specific, tests for other constituents, ash, sulphated ash values, carbonisable matter, oxidisable matter, optical activity, loss on heating/drying etc. taking selected representatives from latest I.P. compounds (15-20 compounds to be given).
- b) Preparation of simple organic pharm compound including recrystallisation, MP/ BP/ Yield and of yield calculations and preparations are to be included.

*1.A. Experiments for Monograph Analysis: (atleast 15 of following)*

1. Acetanilide, Aspirin, Phenacetin, paracetamol.
2. Ascorbic acid, caffeine citrate, Aminophyllin.
3. INH, Piperazine citrate, dextrose, sulphanilamide.
4. Resorcinol, salicylic acid, Benzoic acid, catechol.
5. Hexamine, sulphanilic acid, sodium lauryl sulphate, calcium gluconate.
6. Ibuprofen, Phenylbutazone, Oxyphenbutazone, pyroxicam.
7. CPM, Diethyl carbamazine citrate, Nitrazepam, Metromidazole.

*1.B. Experiments on preparation/synthesis of drugs: at least 8 of following:*

8. Aspirin by acetyl chloride method (Alternate acetic anhydride method).
9. Benzoic acid and Benzyl alcohol  
(Cannizzaro method, alternate: Oxidation of toluene).
10. Picric acid
11. Methyl salicylate
12. Sulphanilic acid
13. Dibenzal acetone
14. Benzanilide
15. Phenyl azo Beta Naphthol
16. Phenacetin
17. Hexamine
18. Sulphanilamide/Dapsone/Benzocaine  
i.e., Experiments on Assays: (atleast 6-8 of the following)
19. Aminophyllin
20. INH
21. Hexamine
22. Sulphanilamide
23. Oxyphen-butazone
24. Phenylbutazone
25. Diethyl carbamazine
26. Benzyl penicillin



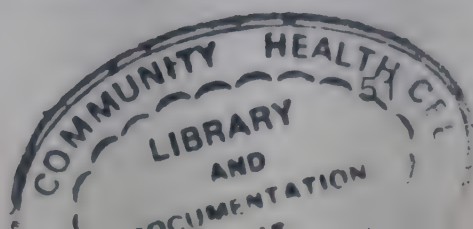
27. metronidazole
28. Diazepam
29. Ampicillin

## REFERENCE BOOKS

- |  |   |
|--|---|
| 1. Burger's Medicinal Chemistry  | - M.E. Wolff, Ed. Tohn Wiky and Sons, New York.   |
| 2. Wilson and Giswold's text book of organic Medicinial and pharmaceutical chemistry | - R-7 Deorge.   |
| 3. W.C. Feye, Principles of Medicinal chemistry,                                     | - Lea and Febiger, Philadelphia.  |
| 4. Martindale, The Extra Pharmacopoeia,  | - J.E.E. Reynolds<br>Ed. The pharmaceutical press, London.  |
| 5. Practical pharmaceutical chemistry,   | - A.H. Beckett, and J.B. Stanlake and Garrel,<br>The Sthalone Press, University of London, London.                      |
| 6. Pharmacopoeia of India,   | - Government of India Ministry of Health.   |
| 7. Text book of practical organic chemistry including qualitative organic analysis.  | - B.S. Furwis, A.J. Harraford, V. Regers, P.W.G. Smith, and A.R. Tatechell, Vogel<br>The English Language Book Society. |
| 8. Practical organic chemistry,  | - J.G. Mann and S.C. Samnders<br>Laogmas Greens and Co Ltd., London.  |

## 3.2 PHARMACEUTICAL ENGINEERING

1. Units and their conversion, Material balance, problems related to stoichiometry.
2. Mechanical Separation, Screening and sieving equipments, theory of sedimentation and Stoke's law. Dorr's thickner, Elutriation, hydraulic and air separators. Bag filters and cyclone separators. Theory of filtration, Kozeney's equation, filter media, filtration equipment and filter aids. Theory of centrifugation, centrifuges.
3. *Mixing*  
Mixers for powders, pastes and liquids. Theory of mixing.
4. *Flow of fluids*  
Fluid statics, manometers, fluid dynamics, Reynolds experiment, Bernoullis theorem, frictional losses in pipes, Valves, flow meters.
5. *Material Handling*  
Construction and working of belt conveyors, screw conveyors and pneumatic conveyors. Reciprocating pumps, diaphragm pump, rotary pump and centrifugal pumps.



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6. *Heat transfer*  
Concept of heat flow by conduction through single wall. Application of Fourier's law. Forced and natural convection, surface coefficients, Boiling liquids, condensing vapours, temperature gradient in parallel and counter current heat exchangers.
7. *Heat interchangers*  
Heat interchangers, Radiation Stefan-Boltzmann equation, heat insulation.
8. *Drying*  
Definition, Theory of drying, classification of driers, construction and working of tray drier, vacuum drier, spray driers, drum drier, fluidized bed drier and lyophilizer.
9. *Evaporation*  
Evaporator types, heat and material balances, Steam jacketted kettle. Horizontal and vertical tube evaporators, multiple evaporators, their theory and economy.
10. *Distillation*  
Theory of distillation of binary mixtures of miscible liquids. Theory of rectification azeotropic distillation, steam distillation, extractive distillation, fractional and molecular distillation.
11. *Corrosion*  
Classification, mechanisms of corrosion. Prevention and control of corrosion merits and demerits of materials of plant constructions such as iron, steel, glass, aluminium, rubber, plastic and lead.
12. *Crystallisation*  
Crystal habit. Solubility curves Mier's theory, material and energy balances, construction and working of agitated batch crystalliser, Swenson Walker crystallizer, Krystal crystalliser and vaccum crystallizer.
13. *Refrigeration and air conditioning*  
Definition of humidity, humid heat, humid volume, study of psychrometric charts, wet bulb theory, theory of air conditioning and refrigeration and description of the equipments.
14. *Reactor Design*  
Reactor types, basic design equations, factor influencing selection of reactor type, catalytic reactors, physical and chemical rate data, definition and scope of pilot plant.
15. Plant location layout, utilities and services; industrial pollution and control. Industrial hazards and safety.



## REFERENCE BOOKS

- |   |                       |
|---|-----------------------|
| 1. Elementary Chemical Engineering        | - Peter's             |
| 2. Chemical Engineer's Hand Book          | - Perry               |
| 3. Unit operation in Chemical Engineering | - McCabe and Smith    |
| 4. Introduction to Chemical Engineering   | - Badger and Banchero |
| 5. Unit operations                        | - Brown               |

## 3.3 PHARMACOLOGY- II

1. *Pharmacology of drugs acting on blood*
  - i) Haemopoietics, Anticoagulants, Thrombolytic agents and Antiplatelet drugs.
  - ii) Pharmacology of immunosuppressants.
2. *Pharmacology of drugs acting on GIT.*

Appetizers, Digestants, Carminatives, Laxatives and Purgatives, Emetics and antiemetics, Antacids and antacid drugs.
3. *Pharmacology of Oxytocics.*
4. *Study of Hormones and Hormone antagonists*
  - i) Pharmacology of thyroid and antithyroid drugs
  - ii) Pharmacology of sex hormones and oral contraceptives
  - iii) Pharmacology of antidiabetic agents
  - iv) Pharmacology of growth hormone, ACTH.
5. *Chemotherapy*
  - i) Chemotherapy of microbial diseases Mechanism, susceptibility, resistance and selection of antimicrobial agents, combined therapy, prophylaxis of and misuse of antibiotics.
  - ii) Pharmacology of sulphonamides, co-trimoxazole and agents for U.T.I.
  - iii) Pharmacology of penicillins cephalosporins and other Beta lactam antibiotics.
  - iv) Pharmacology of Tetracyclines, Chloramphenicol, Erythromycin.
  - vi) Chemotherapy of tuberculosis and leprosy
  - vii) Chemotherapy of sexually transmitted diseases.
  - viii) Chemotherapy of helminthiasis, amoebiasis, and other protozoal infections
  - ix) Pharmacology of antifungal, antiviral agents
  - x) Pharmacology of antineoplastic agents

## 6. *Bioassays*

- i) Introduction, Principles involved in Bio-assays and Bio-assays listed in I.P.
- ii) Principles and applications of radio immunoassays.

## PRACTICALS

1. To carry out the Bioassay of Ach using frog rectus by bracketing method
2. To carry out the Bioassay of Ach using frog rectus by interpolation method
3. To carry out the Bioassay of Ach using frog rectus by 3- point method
4. To carry out the Bioassay of Histamine using GPI preparation by bracketing method
5. To carry out the Bioassay of Histamine using GPI preparation by Interpolation method
6. To carry out the Bioassay of Histamine using GPI preparation by 3 - point method
7. To carry out the Bioassay of Oxytocin using rat uterus by bracketing method
8. To carry out the Bioassay of Oxytocin using rat uterus by interpolation method
9. To carry out the Bioassay of Oxytocin using rat uterus by 3 - point method
10. To study of effect of drugs on ciliary movements of frog oesophagus
11. To study the effect of drugs on intestinal motility using rodents
12. To study the effect of drugs on Rabbit jejunum preparation
13. To study the effect of drugs on Rat uterus preparation
14. To study the catatonic and anticatatonic property of drugs
15. To study the local anaesthetic property of drugs using Rabbit eye preparation (surface anaesthesia and Mydriatic Miotic)
16. To study the local anaesthetic property of drugs using Guineapig (infiltration an.)
17. To study the local anaesthetic property of drugs using frog (Plexus an.)
18. To study the muscle relaxant property of drugs using Rotarod apparatus
19. To demonstrate effect of drugs on Mammalian heart preparation
20. To demonstrate effect of drugs on Dog blood pressure and respiration.

## REFERENCE BOOK (THEORY)

- |  |  |
|--|--|
| 1. Goodman and Gilman's "The Pharmacological Basis of Therapeutics" latest edition | - Alfred Goodman Gillman, Theodore W Rall<br>Pergamon Press. |
| 2. Lewis's Pharmacology, latest edition  | - James Crossland, Churchill Livingstone.                    |
| 3. Drill's Pharmacology in Medicine  | - Joseph R B Dipalmo,<br>MC Graw Hill Book Company.          |
| 4. Pharmacology and Pharmacotherapeutics   | - R.S. Satoskar and S.D. Bhandarkar,<br>Popular Prakasan.    |



5. Essentials of Pharmacology - *K.D. Tripathi.*
6. Rang and Dale's Text book of Pharmacology
7. Pharmacological Principles of Medical Practice - *Krantz and Care,*  
The Williams and Wilkins Company.
8. Indian Pharmacopoeia.
9. Clinical Pharmacology - *Lawrence and Bennet, ELBS.*

### REFERENCE BOOK (PRACTICALS)

1. Text book of 'in vitro' Practical Pharmacology - *Ian Kitchen, Blackwell Scientific Publications, Oxford, roudon....*
2. Pharmacological experiments on Isolated preparations - *staff of Dept. of Pharmacology, University of Edinburgh (Perry's), E&S Livingstone.*
3. Pharmacological experiments on intact preparations - *staff of Dept. of Pharmacology, University of Edinburgh, (Perry's).*
4. Fundamentals of Experimental Pharmacology - *M.N. Ghosh, Scientific Book Agency, Calcutta.*
5. Handbook of Experimental Pharmacology - *S.K. Kulkarni, Vallab Prakashan, Delhi*
6. Experimental pharmacodynamics, - *T. Koppanyi & A.G. Kazezmar, Burgen Publishing Co.*
7. Screening methods in Pharmacology, - *Robert A Turner, Academic Press.*
8. Evaluation of Dry Activities and Pharmacometrics, - *D.R. Lawrence, A.C. Bacharach.*

### 3.4 BIOTECHNOLOGY

1. Introduction, background, development and scope.

2. *Genetic Engineering*

Biological genetics, DNA/RNA replication, restriction, endonucleases, DNA Ligases, Vectors, hosts, cloning strategies, gene expression in Recombinant DNA.

Application of Recombinant DNA in the manufacture of biological product such as Insulin, human growth hormones, Interferons, Interleukins, vaccines etc.

Detailed study of production of Insulin and Hepatitis B. Vaccine.

Legislation concerning risks in using Recombinant DNA based drugs, patents and marketing.

3. *Animal cell culture*

Techniques, media used, characters in cultures, Hybridoma cultures and their application in the production of monoclonal antibodies.

4. *Plant Biotechnology*

Genetics as applied to Medicinal plants (Mutation, Ploids, Chemical races)

Introduction, plant cells cultures, suspension cultures, Continuous culturing of cell.

Production of secondary metabolites.

Commercial production of Shikonin and Artemisinin.

Biotransformation in plant cells, Immobilisation of cells and enzymes.

Gene transfer to plants using Agrobacterium, Electroporation, Microprojectile techniques. Localisation of transferred genes in genetically modified plants.

Application of Plant biotechnology.

5. *Enzyme Biotechnology*

Introduction to enzymes, commercial use of enzymes, enzyme reactors, immobilized enzyme reactors, application of immobilised enzymes in drug manufacture, drug analysis and research methods used in the manufacture and application of Streptokinase, Urokinase, Hyaluronidase and Asperginase.

6. *Biochemical Engineering*

Introduction to fermentation technology, development and maintenance of Industrial micro-organisms, Batch and continuous fermentations, process controls, oxygen supply and demand, single and multiple bubble aeration, sparger aeration; foam control equipment, scale-up of fermentors. Dynamics of continuous culture.

Method of production of Penicillines, Streptomycin, Riboflavin and Cyanocobalamin.

7. *Biologics*

Introduction, classification of biological preparations used in pharmacy.

Method involved in the production and application of the following :

a) Vaccine - Rabies, Poliomyelitis, Hepatitis B, MMR, BCG, DPT, Typhoid, Cholera, Snake Venom, Tetanus, Immunoglobulins and blood products.

b) Glandular products - Thyroid, Vasopressin, Oxytocin and ACTH.

## REFERENCE BOOKS

- |                                   |                 |
|-----------------------------------|-----------------|
| 1. Monoclonal Antibody Technology | - A.M. Campbell |
| 2. Microbiological methods        | - C.H. Collins  |



- |  |                     |
|--|---------------------|
| 3. Handbook of Enzyme Biotechnology  | - A. Wiseman        |
| 4. Recombinant DNA Technology  | - J.D. Watson       |
| 5. Biochemical Engineering Hand Book   | - Bail and Ollis    |
| 6. Mol. Biology and Biotechnology  | - Smith and Hood    |
| 7. Adv. methods in Plant Breeding and Biotechnology                                    | - D.R. Murrey       |
| 8. Comprehensive Medicinal Chemistry Vol - I   | - Hanch             |
| 9. Tissue culture methods and application,<br>Recent trends in Phytochemistry Vol - II | - Kruse & Patterson |
| 10. Plant tissue and cell culture  | - H.F. Street       |
| 11. Pharmacognosy  | - Tyler and Broady  |
| 12. Remington's Pharmaceuticals Sciences   |                     |

## PRACTICALS

1. Initiation of Culture, animal cell culture
2. Suspension cultures and identification
3. Extraction of constituents from culture
4. Immobilisation of plant cells
5. Isolation of plant enzymes and immobilisation
6. Protoplasm fussion
7. Estimation of DNA, RNA and protein in isolated cell preparation
8. Isolation of RNA from yeast by phenol extraction
9. Seperation and identification of nucleotides by gel electrophoresis
10. Estimation of DNA by Diphenglamine reaction
11. Determination of base composition of RNA by Spectroscopy
12. Estimation of RNA by Orcinol reaction
13. Study of Restriction endonuclease digestion
14. Plasmid isolation and cloning techniques
15. Restriction endonuclease enzyme analysis
16. Isolation of enzymes by affinity chromatography
17. Determination of Michaeli's constant for trypsin
18. Immobilisation of enzymes by covalent bonding copolymerisation and gel entrapment
19. Isolation and identification of B. Lymphocytes from spleen
20. Preparation of monoclonal antibodies by hybridoma technology

## REFERENCE BOOKS

- |   |                 |
|---|-----------------|
| 1. Laboratory Techniques in Biochemistry<br>and Molecular Biology | - Work and Work |
|---|-----------------|

- |    |   |                |
|----|---|----------------|
| 2. | Biochemistry Laboratory Techniques        | - Enykin       |
| 3. | Enzyme Biotechnology                      | - Alon Wiseman |
| 4. | Methods in Enzymology                     | - Kalpan       |
| 5. | An Introduction to Practical biochemistry | - Plummer      |

### 3.5 PHARMACOGNOSY AND PHYTOCHEMISTRY I

#### 1. *Introduction*

Present status, scope of Pharmacognosy, classification of crude drugs.

#### 2. *Phytochemical screening of Natural Products*

- Introduction to phytochemistry. Brief study of types of plant constituents.
- General phytochemical methods used in the isolation, separation and purification of natural products.
- Drug adulteration & evaluation of natural products, (Microscopical, physical, chemical, spectroscopic and Biological methods).

#### 3. *Plant Bio-Synthesis*

- Techniques employed in the elucidation of biosynthetic pathways
- Study of basic metabolic pathways
  - Carbohydrate synthesis & Utilisation
  - Shikimic acid and isoprenoid Bio synthesis
  - Fixed oil Biosynthesis

#### 4. *Carbohydrates and Related Products*

- Introduction, Definition, Classification, Chemical nature, Chemical tests and methods of Isolation and Estimation of Carbohydrates and related products (Acids, Alcohols, Uronic acid).
- Source, method of isolation/production, chemical properties and uses of
  - Honey
  - Starch, Cellulose and Pectin
  - Citric acid.
  - Mannitol and Sorbitol

Chemical characters and uses of important commercial products obtained from the above.
- Definition, general properties, chemical nature, method of isolation and estimation of gums of mucilages.



- d. Source, method of production, characters, chemical constituents, tests, study of substitutes and adulterants of the following  
Acasia, Targacanth, Guar gum, Agar, Alginate, Carragenin, Ispasula, Xanthan gum and Aloe mucillate
- e. Study of surgical products of carbohydrate origin.

## 5. *Glycosides*

- a. Definition, general characters and classification.
- b. Introduction, definition, general properties, occurrence, chemical nature and general methods of isolation, estimation and uses of the following :
  1. Cardiac glycosides    2. Anthracene glycosides    3. Saponins
  4. Cyanogenetic glycosides,    5. Flavanoids    6. Lactones    7. Bitter glycosides.
- c. Source, diagnostic characters, constituents, uses, substitutes and adulterants (Bio synthesis, method of isolation and estimation of active constituents of the drugs underlined along with marketed products in India) of the following :
 

1. <u>Digitalis</u>	2. <u>Strophantus</u>	3. <u>Senna</u>	4. Cascara
5. Aloes	6. <u>Dioscorea</u>	7. Agave	8. Solanum species
9. Liqaurice	10. Ginseng	11. Saikosaponins	12. <u>Wild Cherry</u>
13. Bitter almond	14. <u>Citrus Bio Flavanoids</u>		15. Ruta
16. Vanilla	17. Quassia		18. <u>Kalmegh</u>

## 6. *Tannins*

- a. Definition, chemical nature, tests, general methods of isolation, estimation and uses of Tannins
- b. Source, method of preparation, diagnostic characters, constituents, chemical tests and uses of the following
  1. Nutgalls,    2. Tannic Acid    3. Catechu,    4. Kino

## 7. *Natural Pesticides*

- a. Introduction
- b. Source, diagnostic characters, detailed chemical nature, mode of action and uses of
  - i. Red Squill,                      ii. Pyrethrum,                      iii. Neem,                      iv. Tobacco

## 8. *Marine Pharmacognosy*

Introduction, Important products obtained from marine sources, their chemical nature and uses.

## REFERENCE BOOKS

- |   |  |
|---|--|
| 1. Thin Layer Chromatography  | - <i>Stahl. E.</i>                     |
| 2. Pharm Analysis 3rd edition,  | - <i>Keneeth A. Connas.</i>            |
| 3. Phytochemical methods (A guide to modern techniques of plant analysis) | - <i>J.B. Harborne</i>                 |
| 4. Plant drug analysis  | - <i>Hauagner S. Blads</i>             |
| 5. Modern methods of plant analysis                                       | - <i>Peach &amp; Tracey.</i>           |
| 6. Pharmacognosy  | - <i>Vacro E. Tyler, Hyan R. Brady</i> |
| 7. Pharmacognosy  | - <i>Treale &amp; Evans</i>            |
| 8. Pharmacognosy  | - <i>S.S. Handa &amp; V.K. Kapoor</i>  |

## PHARMACOGNOSY AND PHYTOCHEMISTRY - I (PRACTICALS)

1. Paper chromatography of carbohydrates.
2. T.L.C. of anthraquinones.
3. Column chromatography of anthraquinones
4. Qualitative chemical tests for the identification of carbohydrates, Tannins, Glycosides.
5. Measurement of cells and cell content
6. Ratio values (Quantitative Microscopy).
7. Determination of moisture in crude drugs.
8. Determination of extractive values.
9. Identification (Morphological and Powder microscopy) of drugs studied in theory.
10. Chemical tests for the unorganised drugs studied in theory
11. Isolation of cellulose and preparing derivatives.
12. Isolation of Pectin.
13. Isolation of Citric acid.
14. Isolation of Mucilage.
15. Isolation of Sennosides.
16. Isolation of Tannic Acid.
17. Estimation of Sugar.
18. Estimation of Sennosides.
19. Estimation of Rutin.



## 3.6 DISPENSING AND FORMULATIVE PHARMACY

### 1. *Principles of Dispensing*

Prescription, definition, significance, interpretation, handling, legal and theoretical aspects.

### 2. *Posology and Latin*

Weights and measures. Knowledge of the maximum single dose and maximum daily dosage of important therapeutic agents. Calculation of children and infant doses. A brief study of common Latin terms used in prescription practice.

### 3. *Dispensing of Medications*

A detailed study of the following dispensed medication is necessary. Methods of preparation with theoretical and practical aspects, use of appropriate containers and closures. Special labelling requirements and storage conditions should be highlighted.

a) Powders: Types, advantages, disadvantages, granules, preparation of different types of powders and granules encountered in prescription practice, capsules, types and sizes.

b) Monophasic Oral dosage forms:

1) Monophasic theoretical aspects including commonly used vehicles, essential adjuncts like Stabilizers, Colourants, flavours with examples.

Study of the following Monophasic liquids like Mixtures and concentrates, gargles, mouthwash, throat paint, Douche, Ear drops, Nasal drops and Sprays. Liniments and lotions and enemas, collodians.

c) Biphasic liquid dosage forms:

i) Suspension containing diffusible, indiffusible solids, precipitate forming liquids, tinctures, their preparation and stability. Flocculated and deflocculated suspensions. Use of adjunct like thickening agents, wetting agents and dispersing agents. Formulation.

ii) Emulsions: Definition, preparation, techniques, tests for identification of types of emulsions, classification and preservation of emulsions. Emulsifying machinery.

d) Semi solid dosage forms:

i) Ointments, types of ointments, classification of ointment bases, their advantages and disadvantages and selection of dermatological vehicles. Preparation and stability of ointments. Tests to carry out the release study of drugs from bases. Formulation of ointments.

- ii) Pastes: Difference between ointment and paste, paste base preparation and preservation, uses.
- iii) Jellies: Different types of jellies, Preparation and uses.
- iv) Poultices: Preparation and uses.
- v) Suppository and Passaries

Types of suppository bases, ideal properties of a suppository base, Advantages of suppositories, Preparation and packing of suppositories, stability.

- 4 a. Brief study of Incompatibilities in prescriptions like Physical, Chemical and therapeutic and the methods to overcome the same.
- b. Calculation involving isotonic solutions and Displacement value.

#### 5. *Formulation*

Principles and factors to be considered in the formulation of oral liquid dosage forms like Cough Syrups, Antacid suspensions and Dry syrups.

## PRACTICALS

- I Dispensing of atleast 50 prescriptions covering wide range of preparations such as Mixture, Emulsions, Powders, Lotions, Liniments, Ointments, Suppositories.
- II Formulation of simple dosage forms as dicussed in the theory (About 15 Nos.)

## REFERENCE BOOKS

- 1. Dispensing for Pharmaceutical students - *Cooper and Gunn.*
- 2. Dispensing of Medication - *Eric W. Martin.*
- 3. Pharmaceutical calculations - *M.L. Schroff.*
- 4. Remington's Pharmaceutical Sciences.
- 5. Theory and Practice of Industrial Pharmacy - *Lachmann, Lieberman and Kaning.*
- 6. Dispensing of Medication - *Robertking.*
- 7. Practices of Pharmacy - *Cowlet and Aulton (E.L.B.S.).*



# IV YEAR B. PHARM

## 4.1 MEDICINAL CHEMISTRY - II (THEORY)

The following topics will be discussed with special reference to official natural products and allied semi synthetic derivatives.

1. Discussion of naturally occurring biomolecules of the following types with special reference to their configuration. Stereochemistry, Biological importance (Carbohydrates, fats and oils, proteins, hormones, Steroids, Vitamins, Alkaloids).
2. Carbohydrates of higher plant origin of pharmaceutical importance.  
Classification, nomenclature, method of preparation, structure, characterisation, general reaction of identification of amylose, amylopectin, cyclo dextrins, cellulose derivatives, rhamnose, cymarose, deoxy-sugars, Gentobiose, -streptose, Streptobiose.
3. Peptides and proteins, properties, simple and derived proteins, conjugated proteins, a study of their chemical nature, reactions.  
Elementary study of nucleoproteins, nucleosides, nucleotides and nucleic acids of pharmaceutical/biological importance.  
Enzymes-definition, classification, enzymatic activity in biological and industrial applications.
4. *Alkaloids*  
General Extraction, general methods of determination of structure, classification and chemical nature and medical uses of official alkaloids. Structural elucidation and synthesis of ephedrine, Atropine, Papaverine, Nicotine.
5. *Vitamins*  
Classification, study of chemical nature of vitamins official in I.P. Constitution and synthesis of Thiamine, Riboflavin, Ascorbic acid and Vit.D.
6. *Steroids*  
Nomenclature, test for steroids, methods of isolation, structural features, chemistry of cholesterol, irradiation products and chemistry and ergosterol, chemistry of stigmasterol, Lanosterol and chemistry of bile acids/salts.
7. *Hormones*  
(1) Estrogens, interrelationship of estrone, estradiol, estriol, constitution of estrone synthesis and preparation and medicinal uses of synthetic nonsteroidal estrogenic compounds.

ex: *Bonzesterol hexosterol, dieposterol, stilbestrol, chlortrianisene.*

- (2) Progestins: Skeletal structure and synthesis of progesterone; progesterone derivatives used as oral contraceptives.
- (3) Androgens: Skeletal structure, synthesis of testosterone and structures, chemical names of synthetic anabolic steroids.
- (4) Adrenal Cortex hormones: Classification, chemical nature of cortisone, hydrocortisone, synthesis of cortisone from naturally occurring sapogenine, skeletal structures of important synthetic, corticosteroid analogues such as prednisone, prednisolone, fluomethalone, betamethasone and dexamethasone and triamcinolone, structure activity relationship with their medicinal uses.
- (5) General introduction of proteinaceous, hormones eg: Insulin, oxytocin, vasopressin and their biological importance and chemistry of thyroxine.

#### 8. *Saponin*

Chemical nature, test for sapogenins, structure and their uses of diosgenin, sarsapogenin, sarmenogenin, Hecogenin.

#### 9. *Prostaglandins*

A preliminary discussion, introduction of the nature of these compounds and their biological importance.

#### 10. *Glycosides*

Definition, introduction, structural elucidation, test chemistry and synthesis of Amygdalin and salicin.

A general study of cardiac glycosides of digitalis purpurea and lanata, strophanthus and squill with the importance of aglycone and glycane part with their SAR.

#### 11. *Purines*

Constitution and synthesis of uric acid and caffeine, interrelationship of caffeine, theophylline, theobromine and their medical importance.

#### 12. *Terpenes*

Introduction, basic isoprene units, isoprene rule, classification - mono, di, tri, sesqui terpenes, structure and constitution of geraniol, camphor, alpha-terpineol, structure and interrelationship of limonene, dipentene and alpha-terpeneol, terpene hydrate, cineole and carvone, constitution of menthol and thymol.

Synthesis of ionones (Alpha and Beta)



### 13. Carotenoids

Introduction, source, occurrence, skeletal structure of carotenes, conversion of Beta carotene and Vitamin A. Constitution and synthesis of Vitamin A.

#### REFERENCE BOOKS

- |   |                       |
|---|-----------------------|
| 1. Text book of organic chemistry, Vol II | - I. L. Finar.        |
| 2. Text book of pharmaceutical chemistry  | - Bentley and Drivers |
| 3. Medical chemistry                      | - Burger              |
| 4. Organic Constituents of higher plants  | - Robinson            |
| 5. Pharmacopoeia of India                 |                       |
| 6. Feiser and Feiser                      | - Steroids.           |

#### MEDICINAL CHEMISTRY II (PRACTICALS)

1. Degradation of Natural products - atleast 4 compounds.
2. Test of purity of some official compounds belonging to the class of natural products, atleast five compounds of the pharmacopoeia.
3. Assay of pure natural products and finished preparations source materials and finished preparation of the I.P. atleast 10 preparations.
4. Qualitative analysis of natural products - identification 10 unknown compounds to be practiced.
5. Enzyme catalyzed simple reactions, dehydroxylation, hydroxylation, methylation, demethylation (Selected simple eg)

#### REFERENCE BOOKS

- |  |                      |
|--|----------------------|
| 1. Pharmacopoeia of India                |                      |
| 2. Organic Constituents of Higher Plants | - T. Robinson        |
| 3. Plant Drug Analysis                   | - Haugner, S. Blads. |

## 4.2 MANUFACTURING PHARMACY INCLUDING COSMETICS

### 1. *Tablets*

Types, ideal requirements, classification, granulation methods, general formulations, Compression machines. Difficulties in preparation, evaluation, sugar coating, compression coating, film coating, formulation;- each type two formulations.

### 2. *Capsules*

Hard gelatine capsules, shell formulation and manufacturing, sizes, storage, filling, cleaning, binding, general formulation content evaluation soft gelatine capsules, shell formulation, content formulation, filling microcapsules, advantages, coating materials.

### 3. *Parenterals (Products requiring sterile packaging)*

Definition, types, advantages and limitation, general formulation, vehicles, production procedure, production facilities, controls, tests, selected IP injections, sterile powders, implants, emulsions, suspensions, containers and closures pertinent to sterile preparation; quality assurance tests.

### 4. *Pharmaceutical Aerosols*

Definition, propellents, general formulation, manufacturing and packaging methods, pharmaceutical applications. Evaluation.

### 5. *Radio Pharmaceuticals*

Therapeutic uses; diagnostic uses; facilities and working area, preparation of radio pharmaceuticals, radiopharmaceuticals used in medicine, safety preparations. (I 131 and T<sub>c</sub> 99)

### 6. *Liquid orals*

Formulation; manufacturing and packaging.

### 7. *Ophthalmic preparations*

Requirement, formulations, methods of preparation, containers.

### 8. *Sustained Release Dosage Forms*

Classification, principles, materials, methods and evaluation (in Vivo: in vitro) stability and stabilization of pharmaceutical formulation and accelerated stability studies, Decomposition of medicinal agents.



9. *Introduction to new Drug Delivery system*

Types, methods of preparation, Liposomes, Neosomes, Microspheres and TDD, Transdermal preparations and pumps.

10. Quality Assurance of Pharmaceutical specialities under Serial No 6 to 8 and GMP.

11. Formulation and preparation of following cosmetic preparations:

Lipsticks, Shampoos; Face powder and Talcum powder, Nail lacquers, cold and vanishing cream. Dentifrices, Tooth Powders and tooth paste.

## PRACTICALS

IP and other pharmaceutical products to be selected to illustrate the preparation, stabilization and physical evaluation of powders; capsules; tablets, parenterals, suspensions, emulsions; suppositories, semisolids, liquids, ophthalmics etc.

1 Manufacture of Tablets (Dry and wet granulation methods)

2 a) Ordinary compressed Tablets

b) Soluble Tablets

c) Chewable Tablets

d) Tablets by slugging methods

3 Manufacture of Hard gelatin capsule dosage form

4 Manufacture of Injections.

a) Normal Saline

b) Dextrose 5% wt/v

c) Calcium Gluconate

d) Iodised Oil Injection

e) Ascorbic Acid Injection

5 Formulation and Assay of Liquid dosage Form

1) Milk of Magnesia BPC

2) Strong Ammonium Acetate Soln. IP

6 Quality Control of

a) Tablets

b) Capsules

c) Injections

7 Preparation of following

Lip sticks, Shampoos, Face Powder and Talcum Powders, Cold cream and Vanishing cream, Dentifrices, Tooth powder and Tooth Paste.

## REFERENCE BOOKS

- |  |                               |
|--|-------------------------------|
| 1. Remingtons Pharmaceutical Sciences  | - Mack Publishing Company     |
| 2. American Pharmacy                   | - <i>Sprows and Seal</i>      |
| 3. Industrial Pharmacy                 | - <i>Lachman and others</i>   |
| 4. Physical Pharmaceutics              | - <i>Schotten and Ridgway</i> |
| 5. Bentleys Text Book of Pharmaceutics | - <i>Rawlins</i>              |
| 6. Pharmaceutical Formulations         | - <i>Prof. Mithal</i>         |
| 7. Practice of Pharmacy                | - <i>Aulton</i>               |
| 8. Modern cosmeticology                | - <i>Hary</i>                 |
| 9. Cosmetic Technology                 | - <i>Hibbot</i>               |
| 10. Cosmetic sciences and technology   | - <i>Balsam and sagarin</i>   |
| 11. Perfumes and cosmetics             | - <i>Poucher.</i>             |

## 4.3 BIOPHARMACEUTICS AND PHARMACOKINETICS

### 1. *Biopharmaceutics*

Definition, Absorption, Factors affecting absorption - Biological factors, Physiological factors, Physic - chemical factors and pharmaceutical factors; Methods of measuring absorption rate - In vitro, In situ and In vivo methods.

Active and Passive transport and other absorption processes.

### 2. *Bioavailability*

Concept of Bioavailability, chemical equivalent, Biological equivalent, Therapeutic equivalent, Bioequivalence, Measurement of Bioavailability, AUC, measurement of AUC, Origin of variation, examples of drugs showing bioavailability variations. Factors influencing bio-availability, Blood level curves - Drug concentration in blood and blood fractions, concentration following IV, IM and SC Injection, concentration following Oral dose. Comparison of different routes, Multiple dosing Drug delivery to prolong duration.

### 3. *Dosage Regimen*

Introduction, Accumulation during repetitive dosing, Adjustment of dosage regimen in renal failure. Multiple dosing of constant rate IV infusions.

### 4. *Pharmacokinetics*

Definition, Pharmacokinetic considerations, IV administration constant rate IV infusion Final mathematical equations and their applications, Kinetics of distribution, Metabolism, Excretion, concept of compartment model - One compartment and two compartment model, their limitations.



## REFERENCE BOOKS

- |   |                                 |
|---|---------------------------------|
| 1. Pharmacokinetics                                     | - Milo Gibaldi & Donald Perrier |
| 2. Biopharmaceutics and Pharmacokinetics                | - Robert E. Notari              |
| 3. Drug Disposition and Pharmacokinetics                | - Stephen H. Curry              |
| 4. Principles and Perspectives in drug bio-availability | - S. Karger                     |
| 5. Pharmaceutics and Pharmacy Practice                  | - Gilbert S. Banker             |
| 6. Remington's Pharmaceutical Sciences.                 |                                 |
| 7. Dissolution, Bio-availability and bio-equivalence    | - Abdou                         |
| 8. Pharmacy Review                                      | - Leon Shargel                  |
| 9. Industrial Pharmacy                                  | - Lachman                       |
| 10. Current Concept in Pharmaceutical Sciences          | - James Swarbrick               |

## 4.4 INSTRUMENTAL METHODS OF ANALYSIS

### Note :

*The subject is to be discussed with special reference to quality assurance of pharmaceuticals, its scope and its importance in pharmaceutical industry. The following analytical techniques will be discussed with suitable examples for details.*

#### 1. *Absorption spectroscopy*

Theory-Atomic and molecular spectra Lambert-Beer's law.

Instrumentation, selection of filters, monochromators and spectrophotometers available.

Applications of UV, IR and visual spectroscopy in pharmacy, Photometric titration.

Briefly outlay regarding-correlation of electronic absorption spectra and infra red spectra with molecular structures.

#### 2. *Fluorimetry*

Theory instrumentation factors affecting fluorescence, luminescence, indicators, fluorimeter, spectrofluorimeters and applications.

#### 3. *Turbidimetry and Nephelometry*

General principles, instrumentation and pharmaceutical applications.

#### 4. *Flame Photometry*

General discussion, instrumentation (Flame Photometer) and pharmaceutical applications.

5. Introduction of NMR Spectroscopy

6. *Electrometric Methods*

Potentiometry: Types of electrodes with their working, measurement of potential, pH meters, evaluation of end point, Null point potentiometry, potentiometric titration.

Conductometry: Conductance, conductivity, theory involved types of conductometric titrations, principles of wheat stone bridge, applications.

Polorography: Theory, Current, voltage, curve, Half wave potential Instrumentation in quatitative analysis.

Amperometric Titrations: Theory and classification of amperometric titrations eg., inter pretation of graphs.

7. Elementary study of X-ray methods (Crystallographic studies only) and ESR.

8. Principles and different methods of chromatography instrumentation involved in Gas chromatography and HPLC with detectors and applications.

Gel Filtration, affinity chromatography.

Principles instrumentation involved in electrophesis with practical applications.

Ion exchange chromatography, introduction theory, classifications, chemistry involved with applications in Ion exchange process in pharmaceutical analysis.

## **INSTRUMENTAL METHODS OF ANALYSIS (PRACTICALS)**

Exercise representing and elaborating principles discussed in theory will be included in the practical scheme.

1. Ascending paper chromatography of a mixture of alkaloids or aminoacids.
2. Circular paper chromatography
3. Thin layer chromatography
4. Use of cation and anion exchange resins
5. Use of colorimeter-selection of a proper filter and finding out the lambs max \ max of any coloured solution
6. Estimation of a drug (eg. salicylic acid) by colorimetry
7. Use of a fluorimeter (determination of quinine sulfate or Vitamin B2)
8. Estimation of ferrous ion or sulfamilamid by spectrophotometric method
9. Estimation of a drug (eg. Paracetamol) by spectrophotometric method
10. Use of turbidimeter or nephelometer (eg. determination of sulfate ion or chloride ion)



11. Use of pH meter in acid base titrations.
12. Use of potentiometer for titration (eg. ferrous ions by potentiometry)
13. Use of a conductometer for titrations (eg. determination of mineral acids in vinegar, HCL X NaOH titration).
14. Determination of concentration of an ion using a polarograph.
15. Vitamin assay - Raboflavin, thiamine, Vit C, Vit A (instrumental).
16. Alkaloidal assay Quinine, reserpine (instrumental methods).

### REFERENCE BOOKS

- |   |                              |
|---|------------------------------|
| 1. Pharm. Analysis  | - Higuchi. T and Hansen E.B. |
| 2. Quantitative Pharm. Analysis                                       | - Jenkin.                    |
| 3. Quantitative Drug Analysis   | - Garrot. D                  |
| 4. Undergraduate Instrumental Analysis                                | - James E. Robinson          |
| 5. Instrumental Analysis  | - Willard and Meritt         |
| 6. Instrumental Analysis  | - Ewing                      |
| 7. Text Book of Quantitative Analysis including Instrumental methods. |                              |
| 8. Methods of Drug Analysis   | - Gaevien and B F Grabowski  |
| 9. I.P./B.P./U.S.P./Extra Pharmacopoeia                               |                              |
| 10. Text Book of Pharm. Analysis                                      | - Connan                     |

## 4.5 PHARMACOGNOSY AND PHYTOCHEMISTRY - II

### 1. *Essential Oils and terpenes*

- a. Introduction, definition, general properties, different methods of extraction, chemical nature and classification.
- b. Source, method of production, chemical nature, analysis and uses of the following:

- |                   |                   |                   |
|-------------------|-------------------|-------------------|
| 1. Clove Oil      | 2. Mentha Oil     | 3. Sandalwood Oil |
| 4. Eucalyptus Oil | 5. Citronella Oil | 6. Cinnamon Oil   |

### 2. *Carotenoids*

Source, occurrence, isolation, properties of carotenoids.

### 3. *Resins*

- a. Definition, general properties and classification.
- b. Source, method production, chemical nature, chemical tests and uses of the following:
  1. Rosin                      2. Myrrh                      3. Benzoin                      4. Balsam
  5. Storax                      6. Asafoetida                      7. Guggul
- c. Source, diagnostic characters, chemical nature and uses of
  1. Cannabis    2. Podophyllum                      3. Malefern,    4. Ginger.

### 4. *Alkaloids*

- a. Introduction, definition, chemical nature, properties, chemical tests, general methods of isolation, characterisation, estimation and classification (Macroscopy and powder drug microscopy).
- b. Source, diagnostic characters, chemical constituents, uses, substitutes, adulterants and specific tests. (Principle involved in the Bio-synthesis, Isolation and estimation of the active constituents of the drugs underlined alongwith examples of marketed products in India and study of important semisynthetic derivatives).

- |                      |                             |                      |                    |
|----------------------|-----------------------------|----------------------|--------------------|
| 1. Lobeline          | 2. <u>Solanaceous drugs</u> | 3. Coca              | 4. Cinchona        |
| 5. <u>Ipecac</u>     | 6. Berberis                 | 7. Phytostigma       | 8. Curare          |
| 9. Pylocarpus        | 10. <u>Opium</u>            | 11. <u>Rauwolfia</u> | 12. <u>Vinca</u>   |
| 13. Ergot            | 14. Aconite                 | 15. Veratrum         | 16. <u>Ephedra</u> |
| 17. <u>Colchicum</u> | 18. Kurchi                  | 19. <u>Tea</u>       |                    |

### 5. *Lipids*

- a. Fixed oils - source, method of production, chemical composition, tests, uses of the following:
- b.
  1. Olive oil                      2. Castor oil                      3. Sesame oil    4. Arachis oil
  5. Chaulmogra oil                      6. Coca and Cocum butter                      7. Bees wax
  8. Spermaceti                      9. Jajoba                      10. Woolfat.
- c. Fatty acids - general methods of isolation, purification and estimation, source, chemical nature, uses of stearic acid, oleic acid, linoleic acid, undecylenic acid and other derivatives.
- d. Phospholipids and Gylcolipids  
Introduction and nature of Lecithins and Cephalins.



6. *Plant Enzymes*
  - a. Introduction, classification, properties, general methods of isolation and purification.
  - b. Source, method of preparation, chemical nature and uses of the following
    1. Diastase      2. Papain,      3. Chymopapain,      4. Bromelain.
7. *Products of Proteins*
  - a. Definition, tests, and classification of proteins.
  - b. Source, preparation, chemical nature and uses of the following:
    1. Gelatin and its products      2. Microfibrillar Collagen      3. Surgical sutures
    4. Heparin      5. Protamine
8. Allergens and Allergenic Preparation/Sensitivity  
Testing, preparation of allergenic extracts and, treatment of allergy.
9. *Chemotaxonomy*
  - a. Definition, introduction, techniques used (Descriptive, dynamic, serotaxonomy and DNA hybridization).
10. *Study of Herbal Preparation and their Standardisation*
  - a. Preparation of total extracts, exudates, tinctures.
  - b. Methods of stabilization of total extracts and natural exudates.
  - c. Analysis of finished formulation.
11. Role of Herbs in Cosmetics
  - a. Introduction.
  - b. Collection and processing of Herbs for cosmetics.
  - c. General methods for analysis.
  - d. A general study of the traditionally used Herbs in cosmetics, skin care and hair care.
12. Study of few Drugs (any 10) commonly used in indigeneous formulations for the following:
  1. Hypotensive
  2. Hepatoprotectives
  3. Immunostimulats
  4. Arthritis
  5. Diabetes

## REFERENCE BOOKS

- |   |  |
|---|--|
| 1. The essential oils                                   | - <i>Earnest Guenther (Volumes)</i>      |
| 2. Alkaloids  | - <i>Manske.</i>                         |
| 3. Mademen methods of plant analysis Vol I to XII       | - <i>Paech and Tracey.</i>               |
| 4. Tissue Culture and plant science                     | - <i>Edited by Street, 1974.</i>         |
| 5. Plant Tissue culture as a source of bio-medicinals   | - <i>Edited by Stabs.</i>                |
| 6. Pharmacognosy  | - <i>Varee E. Tylor Lyne R.Bready.</i>   |
| 7. Pharmacognosy  | - <i>Trease and Evans.</i>               |
| 8. Chemical constitution of natural fats                | - <i>T.P. Eldich and P.N. Williams.</i>  |
| 9. Pharmacognosy  | - <i>C.K. Kokate and A.P. Purohit.C.</i> |
| 10. Pharmacognosy                                       | - <i>S.S. Handa and V.K. Kapoor.</i>     |
| 11. Pharmacognosy                                       | - <i>S.B. Gokhale and C.K. Kokate.</i>   |
| 12. Chemistry of organic natural products Vol I and II. | - <i>O.P. Agarwal,</i>                   |

## PRACTICALS

1. Extraction of volative oil (Clove oil, Citronella and Mentha oil).
2. Determination of Aldehyde, Alcohol, Phenol & Ester contents of volatile oil.
3. Identification, study of diagnostically important characters of drugs studied in theory (Along with microscopy of powdered drugs).
4. Chemical tests for secondary cell constituents studied in theory and for unorganised drugs.
5. Identification of oils by chemical tests.
6. Isolation of caffeine.
7. Isolation of quinine.
8. Isolation of Berberine.
9. Isolation of fatty acids and their identification.
10. Isolation of papain.
11. Isolation of Bromelein - separation of carotines by column chromatography.
12. Estimation of Alkaloids by Titrimetric and calorimetry methods.
13. Estimation of Ephedrine by non-aqueous titration.
14. Estimation of quinine by Flourimetry.
15. T.L.C. of alkaloids and fatty acids.
16. Determination of Amino acids.
17. Identification of indigeneous traditional drugs.
18. Isolation of phytosterol.



## REFERENCE BOOKS

1. I.P.B.P. and U.S.P.
2. The essential - *Ernest Guenther (Volume)*
3. Practical pharmacognosy - *C.K. Kokate.*
4. Practical evaluation of  
phytopharmaceuticals - *Brain and Turner.*
5. Introduction of organic laboratory  
techniques - *D.L. Pabia.*
6. Natural products - A laboratory guide - *Raphel E.Khan*
7. Plant drug analysis - *H.Wagner S. Bladt and Em.Zagainsky.*

## 4.6 PHARMACEUTICAL MARKETING

1. Principles of book keeping (Preparation of trial balance, profit and loss account and balance sheet).

Principles of Economics: Laws of demand and supply, demand schedule and demand curves; Rent, wages, interest and profits; Productivity, income and expenditure of individuals corporate bodies, inland and foreign trade, export and import of goods.

Office management techniques, secretarial services, record keeping systems (filing).

### 2. *Marketing*

- a. The meaning and scope of marketing - General and environmental scope of Pharmaceutical marketing.
- b. The Pharmaceutical market - Quantitative and qualitative aspects, size and composition of the market, demographic description and socio psychological characteristics of the consumer.
- c. Analysing the market - Role of market research; role of clinical trials, market segmentation.
- d. Consumer profile - Motivation and prescribing habits of the physician, motivation of the ultimate consumer, the patient, his attitude to drugs and disease, his choice of physician and retail pharmacist.

### 3. *The Pharmaceutical product*

- a. Market consideration in product development - Product classification, product planning, product differentiation, imitation, modification of existing product.

- b. New product development - All stages from the new product idea to the stage of marketing the development product to be covered.
4. *The market organisation*
  - a. Manufacturer-  
Company objectives, influence of the internal controls such as company policy and organisation on the company's operation, effect of Government regulations and controls on marketing practice.
  - b. The Wholesaler-  
His role in distribution of pharmaceutical services offered to the manufacturer and the retailer, advantages and disadvantages of distribution through wholesales.
  - c. The Retailer-  
Classification of retail institution, the hospital as retail outlet.
5. *Competitive practices in the Pharmaceutical industries*
  - a. Product differentiation - Effect of patent laws, trade marks laws.
  - b. Price competition - Pricing, discounts to trade, profession and rate contracts.
  - c. Non price competition - Competition through research and development, competition through quality and control.
6. *Marketing Communications*
  - a. Media for communication - Advertising, direct, mail, professionals, journals, sampling, retailing, medical exhibition, public relations.
  - b. Detailing - Purpose of detailing, duties, selection and training compensation and future prospects of the detailman.

## REFERENCE BOOKS

- |  |   |
|--|---|
| 1. Pharmaceutical Marketing in India             | - S.V. Subba Rao, Asian Institute of Pharmaceutical Marketing, Hyderabad. |
| 2. Principles of Marketing                       | - Philip Kotler, Eastern Economy Edition.                                 |
| 3. Principles and Methods of Pharmacy Management | - Smith Lea and Fibiger   |
| 4. Pharmacy Management                           | - Partric and Lecca, American Pharm. Association.                         |
| 5. Accountancy of Commerce                       | - T. Krishna Rao and V.V. Raman.  |
| 6. A Text Book of Pharmacy Management            | - H.W. Tamski, Kogan Press, Great Britain.                                |



- |  |  |
|--|--|
| 7. Manufacturing Organisation and Management | - Harlong T. Amrine, John A. Rietche, Olives Halley, Prentice Hall of India. |
| 8. Salesmanship                              | - Fridrick A. Russel, Mc Grawhill & Co.                                      |
| 9. Double Entry Book Keeping                 | - Batliboi.  |
| 10. Advanced Accountancy                     | - Batliboi.  |
| 11. Laboratory Administration                | - E.S. Hiscousis, Macmillan and Co.  |
| 12. Text Book of Salesmanship                | - Fedrick A. Russell/Frant HB International Student Edition, Mc Graw Hill.   |

## 4.7 PHARMACEUTICAL JURISPRUDENCE

1. Historical background for Drug Legislations
2. Study of Drugs and Cosmetics Act 1940 and Rules as ammended update with special reference to
  - a) Legal definitions
  - b) Statutory bodies namely - Drug Consultative Committee, Drug Technical Advisory Board and Central Drugs Technical Advisory Board and Central Drugs Laboratories
  - c) Import of drugs and cosmetics - Prohibited drugs and cosmetics from being imported, punishment for violations
  - d) Provisions relating to indigeneous manufacture and sale of drugs - plea under section 19
  - e) Qualification, duties, powers and procedure for Inspector, Government Analyst, Licensing Authority and Controlling Authority
  - f) Classification of drugs on the basis of schedule and their relevance and importance
  - g) Provision of
    - i) Second schedule to the Act
    - ii) Schedule D, FF, J, K, N, O, P, Q, R, S, T, U, U1, V, Y
  - h) Good manufacturing practices (Schedule M)
  - i) Licensing of
    - a) All types sales establishments
    - b) All types of Manufacturing units
    - c) Imports of drugs
    - d) Approved laboratories

- j) Punishment clause
  - k) Labelling of drugs
3. Study of Pharmacy Act 1948, composition of Central and State Pharmacy councils, their functions, education regulations - Registration of Pharmacists and related provisions
  4. Study of Drugs (Prices control) order 1988 or the order in force
  5. Study of Essential Commodities Act relevant to Drugs (Price control) order
  6. Study of Salient features of Drugs and Magic remedies Act and rules
  7. Narcotics drugs and Psychotropic Substance Act with special reference to regulations for illicit use of Narcotic drugs and psychotropic substances
  8. Drugs Abuse
  9. Inspection of Sales and Manufacturing units
  10. Medicinal and Toilet Preparations Act and Rules
  11. Poisons Act and Rules
  12. Pharmaceutical Ethics and Codes
  13. National Drug policy
  14. Role of W.H.O in regulatory affairs

### REFERENCE BOOKS

1. Report of the Pharmaceutical enquiry committee
2. Report on the working of the Drugs Standard Control in India
3. Martindales Pharmacopoeia
4. Remingtons Practice of Pharmacy
5. All the relevant Acts and Rules thereunder referred in the syllabus
6. Laws of Drugs - Beotra
7. Forensic Pharmacy - B.M. Mithal
8. Drug addiction with special reference to India - R.N. Chopra and I.C. Chopra, Council of Scientific and Research, New Delhi
9. Drug Abuse Proceedings of the international conference - Ceris S.D. Zarafonitis.



## 4.8 CLINICAL AND HOSPITAL PHARMACY

### I Clinical Pharmacy

1. Basic concept of pre-clinical and clinical evaluation of new drugs
2. Drug Interactions
  - i) Introduction, classification, mechanism, clinical significance and importance of drugs interactions, collection of information about drug interaction.
  - ii) Drugs - Drug interaction of
    - a) Antiarrhythmic drugs
    - b) Oral anticoagulants
    - c) Anti convulsants
    - d) Antidiabetics
    - e) Anti hypertensives
    - f) Anti infectives
    - g) Anti neoplastics
    - h) Hormones
    - i) MAO inhibitors
    - j) Tricyclic antidepressants and miscellaneous
3. Drug - food interactions
4. Pharmacist patient relationship
5. Community pharmacy

### II Hospital Pharmacy

1. Hospital pharmacy, its organisation, personnel and functions
2. a. Pharmacy and therapeutic committee  
Definition, Constitution and Functions
- b. Drug information service
3. Hospital Publications - Hospital formulary, Pharmacy bulletin
4. Purchase and Inventory control
5. Central sterile supply department  
Definition, Organisation, Layout, Functioning
6. Dispensing: Inpatient, Outpatient, Ambulatory patients,  
Dispensing during off hours, Medication errors
7. Drug Distribution Channels
8. Investigational use of drugs

9. Control drug substances, Procurement, Distribution, Storage, Handling of prescriptions
10. Maintenance of Records and Reports

## PRACTICALS

1. Preparation of IV Fluids (a) 5% Dextrose with Saline (b) Saline Solutions, (c) Dialysis solution (d) Ophthalmic preparation (e) Nasal drops (f) Dusting powders (g) Pyrogen testing
2. Report of visit to different Hospitals
3. Experiments on in vitro drug interactions
4. Experiments on in vivo drug interactions
5. Experiments on drug and food interactions
6. Analysis of prescriptions for drug - drug interactions.

## REFERENCE BOOKS

- |  |   |
|--|---|
| 1. Clinical Pharmacy and Therapeutics                | - Ed. Eric T. Herfindal, Dick R. Gourley, Lind Llord Hart. (Williams and Wilkins)     |
| 2. Remington's Pharmaceuticals Sciences              | - Ed. Alfonso R. Gennaro<br>(Mack Publishing Company)                                 |
| 3. Hospital Pharmacy                                 | - William E. Hassan Jr.,<br>K.M. Vargheese Company                                    |
| 4. Drug Interactions                                 | - Philip D. Hansten   |
| 5. Drug Interactions                                 | - Dr. B.K. Mehra,<br>Basic and Business Publication, Bombay                           |
| 6. Clinical Pharmacy Practice                        | - Charles W. Blissit, O.Lynn Webb, Walter F. Stanaszek, Lea and Febiger, Philadelphia |
| 7. Principles and methods of Pharmacy Management     | - Harry A. Smith, Lea and Febiger   |
| 8. Drug Dilemmas, Adverse Relations and Interactions | - Dr. Ambalal Shah, Dr. Nitin Shah  |
| 9. Handbook of Drug Interactions                     | - Gerald Swidler. Wiley - Inter Science.  |



# APPENDIX

## Accommodation:

Suitable area with adequate ventilation and lighting should be provided. Following accommodation should be provided for an institution sanction with an admission strength of 60 (Sixty only) students.

1.	Principal's Room	1 No.
2.	Office Room	1 No.
	+ Confidential Section	1 No.
3.	Staff Room	4 Nos.
	+ Ladies Staff Room	1 No.
4.	Ladies Common Room	1 No.
5.	Boys Common Room	1 No.
6.	Museum	1 No.
7.	Stores	1 No.
8.	Provision for Gas Plant, Workshop	1 No.

## Following Laboratories/Class Rooms should be provided.

College Running		
	B.Pharm + D.Pharm Courses	B.Pharm + D.Pharm + M.pharm
1. Lecture Hall	4+2	7 Nos.
2. Pharmaceutics Laboratories	4+1	6 Nos.
3. Machine Room	1 No.	1 No.
4. Pharmaceutical Chemistry Laboratory	3+1	5 Nos.
5. Physiological & Pharmacology Laboratory	3+1	5 Nos.
6. Bio Chemistry Laboratory	1 No.	1 No.
7. Pharmacognosy and Tissue Culture Laboratory	1+1	2 Nos.
8. Microbiology Laboratory	1 No.	1 No.
9. Industrial Chemistry and Pharmaceutical Engineering Laboratory	1 No.	1 No.
10. Seminar Room	1+1	4 Nos.
11. Library	1 No.	1 No.
12. Reading Room	1 No.	1 No.
13. Preparation Room for each Laboratory	1 No.	1 No.

14. Balance Room for each Laboratory	1 No.	1 No.
15. Laboratory for Photomicroscopy	1 No.	1 No.
16. Computer Room for Computers	1 No.	1 No.
17. Examination Hall	1 No.	1 No.
18. Medicinal plant Garden	1 No.	1 No.
19. Instrumentation Room	1 No.	1 No.
20. Stores/Chemical/Glasswares etc. (Sub stores for each Laboratory)	1 No.	1 No.
21. Distilled Water Unit for each Department	1 No.	1 No.

Provision should be made for Balance Room, Aseptic Room, Animal House, Froger, etc.

*Floor Area* : Class Rooms ..... 800 Sq.ft. each  
Laboratory ..... 30 Sq.ft/ Student

required to work in the Laboratory at any given time subject to a minimum of 800 Sq.ft. Gas and Water fittings, Shelves, Fume cup boards, exhaust fans etc. should be provided in all the Laboratories.

*Library* : All the books mentioned under each subject head should be provided.

*Journals* : Contribution to all Indian Journals, pertaining to Pharmaceutical profession should be made.

Important Foreign Journals (atleast 5 of them) to keep the staff members informed about the recent developments should be subscribed.

#### Staff pattern for B.Pharm / D.Pharm / M.Pharm Courses Branch Wise

Department of Pharmaceutics	Name of Post	With Intake of 40 Students	Branchwise Intake 60 Students
1. College with B.Pharm only	Professor	1	1
	Asst. Professor	1	1
	Lectures	2	2
2. College with B.Pharm and M.Pharm	Professor	2	2
	Asst. Professor	2	2
	Lecturers	2	2



3.	College with B.Pharm M.Pharm and D.Pharm	Professor	2	2
		Asst. Professor	3	3
		Lecturers	3	4
4.	College with B.Pharm and D.Pharm	Professor	1	1
		Asst. Professor	2	2
		Lecturers	3	4

Department of Pharmaceutical Chemistry		Name of Post	With Intake of 40 Students	Branchwise Intake 60 Students
1.	College with B.Pharm only	Professor	1	1
		Asst. Professor	1	1
		Lecturers	2	3
2.	College with B.Pharm and M.Pharm	Professor	2	2
		Asst. Professor	2	2
		Lecturers	3	4
3.	College with B.Pharm M.Pharm and D.Pharm	Professor	2	2
		Asst. Professor	2	3
		Lecturers	4	5
4.	College with B.Pharm and D.Pharm	Professor	1	1
		Asst. Professor	2	2
		Lecturers	3	4

Department of Pharmacology	Name of Post	With Intake of 40 Students	Branchwise Intake 60 Students
1. College with B.Pharm only	Professor	1	1
	Asst. Professor	1	1
	Lectures	1	2
2. College with B.Pharm and M.Pharm	Professor	1	1
	Asst. Professor	2	2
	Lecturers	2	2
3. College with B.Pharm M.Pharm and D.Pharm	Professor	1	1
	Asst. Professor	2	2
	Lecturers	3	4
4. College with B.Pharm and D.Pharm	Professor	1	1
	Asst. Professor	1	1
	Lecturers	2	3

Department of Pharmacognosy	Name of Post	With Intake of 40 Students	Branchwise Intake 60 Students
1. College with B.Pharm only	Professor	1	1
	Asst. Professor	1	1
	Lecturers	1	1
2. College with B.Pharm and M.Pharm	Professor	1	1
	Asst. Professor	1	1
	Lecturers	2	2
3. College with B.Pharm M.Pharm and D.Pharm	Professor	1	1
	Asst. Professor	1	1
	Lecturers	2	3
4. College with B.Pharm and D.Pharm	Professor	1	1
	Asst. Professor	1	1
	Lecturers	1	2













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